1999

Perceptions of the feasibility of Total Quality Management theories and methodologies in the vocational training system of Taiwan, Republic of China

Hsi-Kong Chin Wang
Iowa State University

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI

A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor MI 48106-1346 USA
313/761-4700 800/521-0600

Perceptions of the feasibility of Total Quality Management theories and methodologies in the vocational training system of Taiwan, Republic of China

by

Hsi-Kong Chin Wang

A dissertation submitted to the graduate faculty

in partial fulfillment of the requirement for the degree of

DOCTOR OF PHILOSOPHY

Major: Industrial Education and Technology

Co-Major Professors: Robert J. Gelina and Roger A. Smith

Iowa State University

Ames, Iowa

1999

Graduate College

Iowa State University

This to certify that the Doctoral dissertation of

Hsi-Kong Chin Wang

has met the dissertation requirements of Iowa State University

Signature was redacted for privacy.

Co-Major Professor

Signature was redacted for privacy.

Co-Major Professor

Signature was redacted for privacy.

For the Major Program

Signature was redacted for privacy.

For the Graduate College

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

The major purpose of this study was to design an instrument to measure the feasibility of implementing TQM (Total Quality Management) theories and methodologies in the vocational training system in Taiwan, R. O. C. as perceived by the instructors at the vocational training centers (VTCs) and the leaders of companies which have sent their employees to VTCs. Specifically, the goals of this study were to identify the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees, to find the level of preference for potential learning opportunities to improve instructors' knowledge of TQM principles and methods, and to express the degree of agreement with strategies that might be used to include TQM practices in the VTCs' curriculum.

Establishing self-reported measures (both English and Chinese) related to core body of knowledge of TQM, TQM learning opportunities, and strategies for including TQM in the curriculum were essential for implementing TQM theories and methodologies at the vocational training centers. The inputs of 351 instructors from 13 vocational training centers and 93 leaders from 150 companies were usable data for statistical analysis. The final instrument used for data collection contained 67 items.

The reliability of the overall instrument was sufficiently high (0.98) for continued use in practical applications. Content validity as approved by Chinese and American experts, and construct validity as verified by exploratory analysis, further demonstrated the usefulness of the instrument.

Estimates of central tendencies revealed the items with the ten highest means representing elements in the core body of knowledge of TQM as: (1) teamwork and people

involvement; (2) understanding customer expectations and requirements; (3) measurement of customer satisfaction; (4) consensus development; (5) knowledge of oneself; (6) continuous improvement; (7) personal commitment and responsibility; (8) development of new knowledge; (9) product design for quality; and (10) proactively seeking feedback from customers. The results suggested that there was a strong need to teach TQM knowledge and skills at vocational training centers.

Both the VTCs' instructors and companies' leaders held positive perceptions with respect to three scales of the instrument. Companies' leaders rated more positively than the VTCs' instructors did on the perceptions of core body of knowledge of TQM. However, there were no significant differences on their perceptions of TQM learning opportunities and strategies for including TQM in the curriculum between the two groups.

The exploratory analysis provided the underlying structure of the instrument and included the following nine factors: (1) continuous improvement; (2) teamwork and active learner; (3) strategies for including TQM into the curriculum; (4) TQM learning opportunities; (5) customer orientation; (6) TQM tools; (7) quality planning and management; (8) definition of quality; and (9) TQM innovativeness.

CHAPTER 1. INTRODUCTION

American and Western European investors have generally been aware of emerging producers in the Far East and Southeast Asia, and also that this region was poised for continued future growth (Rzadzki, 1994). Specific countries identified as emerging producers in this region were China, India, Singapore, Indonesia, Malaysia, Thailand, Vietnam, Korea and Taiwan (Rzadzki, 1994). All these countries have experienced significant economic growth since World War II, some more dramatically than the rest. Specifically, in the case of Taiwan, Republic of China (R. O. C.), the per capita gross national product rose from $50 in 1952 to $6400 in 1988. As of 1987, the trade level of Taiwan was $89 billion, with a surplus of $19 billion, and foreign exchange reserves have reached $70 billion, then one of the largest levels for any country in the world (Wu, 1991). However, since that time, Taiwan has continually faced challenges from countries in Asia and around the world to maintain high levels of economic advantage ("Taiwan-the dream postponed," 1993).

The national political administrators of Taiwan continued to seek methods to improve the standards of industries in the island nation and provide for better standards of living for its more than 20 million citizens ("Taiwan's big prize," 1995; "Taiwan-the dream postponed," 1993). Recent incentives, including awarding "Oscars" for high-performing business, were aimed at encouraging companies to become more innovative, set up their own brand names, and most importantly, produce higher quality products ("Taiwan's big prize," 1995, p. 62). The China External Trade Development Council conducted a $4.2 million advertising campaign to improve the image of Taiwan's products in world markets, and communicate that

most Taiwan-made products were not cheap imitations or poor quality goods (Westbrook, 1993).

Taiwan's initiative to establish national level awards for quality were similar to the Deming Prize established in Japan in 1951, and the Malcolm Baldrige National Quality Award established in the United States in 1987 (Ross, 1995). Thus, the total quality movement, which turned around the Japanese economy after the Second World War and later invaded American business during the 1980s, has only recently received high-level attention in Taiwan. A study of the opinions of middle level managers in Taiwanese and United States manufacturing firms confirmed the presence of a significant relationship between quality constructs and organizational performance (Madu et al., 1995).

Selected Taiwanese firms have recognized the need to improve the quality of their products and services. During the late 1980s and early 90s, Taiwanese automakers overcame a serious challenge from imports by concentrating on quality. In 1989, 42% of all cars sold domestically were imports; in just two years this figure dropped to 25%, and these good results were attributed to improved quality of locally produced automobiles (Shapiro, 1991). In some cases, Taiwanese firms have been assisted by foreign countries in their quality improvement efforts. For example, the Boeing Company from the United States assisted the Taiwanese aerospace industry in establishing a quality assurance laboratory for commercial aircraft parts (Shapiro, 1991).

Even as the total quality movement reached new levels in Japan and continued to maintain momentum in the United States, some Taiwanese companies have been reluctant to accept the market demand for quality. As an example, when the United States House Bill

3000 was originally proposed, it required that fasteners be inspected, tested, and certified as meeting or exceeding prescribed standards for quality. As a reaction to this proposition, the 400 members of the Taiwan Fastener Institute strongly supported the American Fastener Importers Association in a joint effort to defeat the bill. However, ultimately it was the quality conscious companies that received positive attention from the United States government (Andel, 1990). In this case, the initial reluctance of Taiwanese manufacturers to accept customer standards might be attributed to lack of knowledge of quality as a business strategy.

Juran (1995) noted that where as the 20th century became famous for world productivity, the 21st century would become well known as the "century for quality." Ishikawa of Japan believed that education was the most important factor in increasing the level of awareness for quality (Ross, 1995). In the United States, the number of educational institutions offering courses in total quality steadily rose during the 1990s. In addition to quality-related instruction, the system of total quality management (TQM) even became the adopted way of managing educational institutions. Numerous success stories following the implementation of a TQM style of management have appeared in the literature. The influence of TQM in improving the educational programs at George Westinghouse Vocational Technical High School in Brooklyn, New York, provided an example of such positive transformations ("Back to school," 1994).

The "8th Quality in Education" listing (Miller & Daniels, 1998, p. 23) contained 312 names of institutions that focused on quality management principles. Institutions represented included K-12 schools, community colleges, four-year colleges and universities. Among the

312 listings, 25 were located outside of the United States. The most common areas in which quality was practiced included administration (87%), student achievement (77%), teaching methods (68%) and curriculum (63%). Incidentally, none of the institutions listed in this survey were from Taiwan. Studies linking a relationship between TQM-managed institutions and the amount of total quality instruction to students or apprentices were not available. However, it has been widely acknowledged that TQM-related instruction in institutions within the United States accelerated following the publication of an open letter by company leaders of leading corporations ("An open letter," 1991; The Procter & Gamble Company, 1992; Evans, 1996).

In an era of global free trade where geographic barriers in terms of technology transfer were easily overcome, competitive success depended more on the talent and ability of the people rather than latest available technologies (Thurow, 1996). Therefore, education and training of skilled workers were considered highly important (Cheng, 1992/93). In the United States, community colleges were recognized as the most responsive group to the needs of business and its employees (Boyes, 1981). These institutions have been quite active in implementing a total quality curriculum and providing superior preparation of personnel for the workplace of the 21st century (Miller & Daniels, 1998). In Taiwan, much of the responsibility for workforce training and development belongs to nationally established vocational training centers. These institutions are yet to implement total quality-related instruction in their training programs.

Rationale for the Study

Pittam (1987) stated:

> Numerous adages suggest that people are the key to any successful business operation. Despite frequents lip service, there is nonetheless a fundamental truth to these clinches: no human enterprise can succeed without properly skilled and knowledgeable human resources. Hence ongoing employee development is critical to the short- and long-term success of every business (profit or nonprofit). All organizations, either formally or informally, must continually address the training and development of their people. To do otherwise is one means to assure obsolescence and eventual failure. (p. 19)

Organizations based in Taiwan have recognized only recently the potential of total quality management principles in order to survive and succeed in today's global economy. Although manufacturing and allied technologies in Taiwan are as advanced as anywhere else in the world, there are some respects in which Taiwanese companies are lagging behind their competitors such as the United States and Japan. In particular, education related to the practice of total quality management has been either totally absent or rather minimal when compared to American and Japanese companies. Several manufacturing, service, health-care, public sector, non-profit association, and higher educational institutions have initiated TQM programs; however, as a percentage this number is rather insignificant.

Among Taiwanese firms, most large corporations have the resources to provide customized training for their employees, and small and medium scale corporations usually do not have training facilities of their own. Therefore, vocational training centers (established and sponsored by the government) have a major responsibility to prepare the present and future workforce for medium and small-scale companies based in Taiwan. At the present time, such centers do not offer training that addresses TQM concepts and/or associated methodologies for continuous improvement of processes (Employment and Vocational

Training Administration, 1997; Catalog of Vocational Training Centers, 1998; Lin, 1998). It is not exactly known why these centers have not actively pursued the inclusion of TQM in their training curriculum. At the same time, competitors in the United States and Japan have been proactive in educating workers at all levels in TQM and problem solving skills for continuous improvement of processes. If adequate continuing education with respect to quality must be provided to a majority of workers in Taiwan, the vocational training centers must assume leadership.

The training curriculum is decided essentially by vocational training centers and companies that avail of the center's facilities to train their employees. There are no known studies that address the knowledge of TQM possessed by individuals who teach at the center. The attitude of instructors of public vocational training centers and of top management of companies toward training their employees in TQM and process improvement models remains a question that is yet to be answered.

Statement of the Problem

Vocational training centers (VTCs) in Taiwan have not included TQM methodologies in their training curriculum. This places the trainers, skilled workers in manufacturing, and service personnel in Taiwanese enterprises at a disadvantage in a globally competitive economy. The problem is to determine the feasibility of teaching TQM theory and methodologies at the vocational training centers in Taiwan as perceived by the instructors at such centers and by the leaders of companies that have sent their employees to vocational training centers in Taiwan.

Purpose of the Study

The first purpose of this study is to identify the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the vocational training centers as perceived by the instructors at the vocational training centers (VTCs) and by the leaders of companies that have sent their employees to VTCs in Taiwan. Secondly, the study also seeks to find the level of preference for potential learning opportunities to improve instructors' knowledge of TQM principles and methods as perceived by the instructors at VTCs and by the leaders of companies. Finally, the study asks the instructors at VTCs and the leaders of companies to express their degree of agreement with strategies that might be used to include TQM practices into the VTCs' curriculum.

Research Questions

The study will conduct an inquiry that will answer the following questions:

(1) What is the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the vocational training centers as perceived by the VTCs' instructors and companies' leaders?

(2) What is the level of preference for potential learning opportunities to improve instructors' knowledge of TQM principles and methods as perceived by the VTCs' instructors and companies' leaders?

(3) What is the degree of agreement with strategies that might be used to include TQM practices into the VTCs' curricula as perceived by the VTCs' instructors and companies' leaders?

(4) Do the perceptions of the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the VTCs differ between the VTCs' instructors and companies' leaders?

(5) Do the perceptions of level of preference for potential learning opportunities to improve instructors' knowledge of TQM principles and methods differ between the VTCs' instructors and companies' leaders?

(6) Do the perceptions of the degree of agreement with strategies that might be used to include TQM practices into the VTCs' curriculum differ between the VTCs' instructors and companies' leaders?

Statement of Research Hypotheses

The following null hypotheses are proposed:

(1) There are no significant differences in the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the VTCs among the centers' instructors as a function of job titles (H_O 1.1), levels of education (H_O 2.1), years of working experiences (H_O 3.1), hours of training of TQM (H_O 4.1), location (H_O 5.1), type of training program (H_O 6.1), type of sponsoring agency (H_O 7.1), and number of students (H_O 8.1).

(2) There are no significant differences in the level of preferences for potential learning opportunities to improve instructors' knowledge of TQM principles and methods among the centers' instructors as a function of job titles (H_O 1.2), levels of education (H_O 2.2), years of working experiences (H_O 3.2), hours of training of TQM (H_O 4.2),

location (H_O 5.2), type of training program (H_O 6.2), type of sponsoring agency (H_O 7.2), and number of students (H_O 8.2).

(3) There are no significant differences in the degree of agreement with strategies that might be used to include TQM practices into VTCs' curriculum among the centers' instructors as a function of job titles (H_O 1.3), levels of education (H_O 2.3), years of working experiences (H_O 3.3), hours of training of TQM (H_O 4.3), location (H_O 5.3), type of training program (H_O 6.3), type of sponsoring agency (H_O 7.3), and number of students (H_O 8.3).

(4) There are no significant differences in the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the VTCs among the companies' leaders as a function of job titles (H_O 9.1), levels of education (H_O 10.1), years of working experiences (H_O 11.1), hours of training of TQM (H_O 12.1), location (H_O 13.1), type of products (H_O 14.1), type of ownership category (H_O 15.1), and number of employees (H_O 16.1).

(5) There are no significant differences in the level of preferences for potential learning opportunities to improve instructors' knowledge of TQM principles and methods among the companies' leaders as a function of job titles (H_O 9.2), levels of education (H_O 10.2), years of working experiences (H_O 11.2), hours of training of TQM (H_O 12.2), location (H_O 13.2), type of products (H_O 14.2), type of ownership category (H_O 15.2), and number of employees (H_O 16.2).

(6) There are no significant differences in the degree of agreement with strategies that might be used to include TQM practices into VTCs' curriculum among the companies'

leaders as a function of job titles (H_O 9.3), levels of education (H_O 10.3), years of working experiences (H_O 11.3), hours of training of TQM (H_O 12.3), location (H_O 13.3), type of products (H_O 14.3), type of ownership category (H_O 15.3), and number of employees (H_O 16.3).

(7) There are no significant differences in the perceptions of the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the VTCs between the VTCs' instructors and companies' leaders (H_O 17).

(8) There are no significant differences in the perceptions of the level of preferences for potential learning opportunities to improve instructors' knowledge of TQM principles and methods between the VTCs' instructors and companies' leaders (H_O 18).

(9) There are no significant differences in the perceptions of the degree of agreement with strategies that might be used to include TQM practices in the VTCs' curriculum between the VTCs' instructors and companies' leaders (H_O 19).

Assumptions of the Study

The following assumptions are made:

(1) The study assumes that the VTCs' instructors and companies' leaders have basic understanding of the terminology of Total Quality Management.

(2) The study assumes that the subjects respond to the survey instrument truthfully and honestly.

(3) The study presumes that the subjects correctly understood the directions and contents of the instrument.

(4) The original instrument in English was translated correctly to obtain an equivalent Chinese version.

(5) The literature review of Total Quality Management in Taiwan was accurately interpreted from Chinese to the English language where applicable.

Limitations of the Study

The proposed study is open to the following limitations:

(1) Responses to the survey items are subject to personal bias and perceptions of the participating instructors at VTCs and leaders at companies.

(2) The data was collected through the distribution of a written survey instrument and thus limited to responses received from instructors only (no administrators) at the vocational training centers. Likewise, data from companies was limited to responses from the leaders only and not other employees in the companies.

(3) The companies that have sent their employees to vocational training centers represented those corporations only. This limited the generalizability of the study's findings to others companies.

(4) There were unequal numbers of subjects between the VTCs' instructors and companies' leaders, due to practical reasons.

Procedure for Completing the Study

The following steps outline the procedure for completing this study:

(1) The researcher performed a review of literature using materials from both the United States and Taiwan. Resources were located using electronic as well as traditional sources. This review of literature leaded to a precise statement of the research problem.

(2) The instructors working in the thirteen vocational training centers were identified for the study using directories published by the Council of Labor Affairs, Taiwan. The instructors included Full instructors, Associate instructors, and Assistant instructors.

(3) The companies that have sent their employees to vocational training centers were identified for the study using directories published by the Council of Labor Affairs, Taiwan.

(4) The leaders in the companies were identified using the information published by the Ministry of Economics Affairs, Taiwan. The leaders included each company President, Vice President, and Manager.

(5) The survey instrument was developed. Existing literature was examined to create specific items. Field-tested instrument with established validity and reliability was studied to build on existing research and to avoid duplication of efforts.

(6) A panel of experts from both the United States and Taiwan was contacted to validate the designed instrument. The instrument was revised appropriately based on suggestions received.

(7) The human subject's approval form was completed and forwarded to the Iowa State University Graduate College. The final permission to field test the instrument was obtained from the Iowa State University's Human Subjects Review Committee.

(8) Once the approved instrument was ready, a sufficient number of copies were printed for pilot testing. A cover letter was also prepared. A pilot test was conducted in Taiwan. The instrument was revised based on the results of the pilot test.

(9) The finalized survey instrument with a new cover letter was mailed to the subjects. At least one follow-up mailing was utilized to increase the return rates.

(10) Response data was coded and analyzed using the Statistical Package for the Social Sciences (SPSS). Both descriptive and inferential statistical analysis procedures were completed. The research hypotheses were tested. The theoretical and practical significance of the results was examined.

(11) A final written report was prepared for the examination and approval of the Program of Study (POS) committee members.

Definition of Terms Specific to This Study

Leaders: Company personnel who hold any one of the titles President, Vice President, or Manager.

Instructors: Individuals who teach at any one of the thirteen vocational training centers. Includes Full, Associate, and Assistant instructors.

Vocational training center: Government-sponsored institutions that provide training opportunities for any citizen who seek to be trained for employment.

Perception: An active or passive process that involves the conscious organization of

incoming information (Kerr, 1982).

Total quality management (TQM): It is the integration of all functions and processes within an organization in order to achieve continuous improvement of the quality of goods and services. The goal is customer satisfaction (Ross, 1995).

Quality circle: A group of employees that meets regularly for the purpose of identifying, recommending, and making workplace improvements. The members are volunteers who convene themselves and conduct their own meetings (Goetsch & Davis, 1997).

Quality: The totality of features and characteristics of a product or service that bears on its ability to meet stated or implied needs (ANSI/ISO/ASQ A8402-1994).

ISO 9000: It is a set of five worldwide standards that establish requirements for the management of quality. Specially, the five standards are: (a) ISO 9000: a guidance standard; (b) ISO 9001: a conformance standard for companies that design and manufacture; (c) ISO 9002: a conformance standard for companies that manufacture but not design; (d) ISO 9003: a conformance standard for service companies; and (e) ISO 9004: a guidance standard (Ross, 1995).

Theory of constraints: It is a management philosophy that focuses the organizations scarce resources on improving the performance of bottlenecks within the system and directing all efforts toward achieving the ultimate goal of the system (Goldratt & Cox, 1986).

CHAPTER 2. REVIEW OF LITERATURE

Total quality management (TQM) is a concept that has invaded business and industry not only in the United States and Japan, but also in many other countries of the world. TQM has been widely practiced under a variety of names and acronyms that have been creatively coined by management experts (Marchese, 1993). Japanese business and industry were the first among their counterparts in the world in implementing a company-wide management strategy that established quality as the criterion for competing in world markets (Deming, 1986). During the 1980s and 90s, the total quality message became increasingly popular in many other industrialized nations including the United States (Ross, 1995). In fact, the airing of the television documentary "If Japan Can Why Can't We" (Johnson & Dugger, 1996, p. 35) in June, 1980, featuring the most famous of all quality gurus, W. Edwards Deming, has been acknowledged as the most significant event that awakened the quality management movement in North America (Seymour, 1993). The newly industrialized nations, particularly those in Southeast and Eastern Asia, such as South Korea, Malaysia, Indonesia, and Taiwan, also have continued to witness an increased interest in quality management practices (Goetsch & Davis, 1997).

Production-related enterprises were generally the first to realize and apply the principles of TQM in business practice. However, by the year 1997, the influence of TQM has spread into different sectors of the economy, including a wide array of service industries such as healthcare, hospitality, telecommunications, and transportation. Several governmental

agencies and educational institutions at all levels have demonstrated an active interest in TQM by practicing the philosophy and documenting their success stories.

Definition and Meaning of Total Quality Management

Total quality management was a philosophy of managing organizations; therefore, it lacked a rigid, universally acceptable definition (Witcher, 1995). However, recent thinkers have put forth their interpretations of total quality management. According to Ross (1995), "Total quality management is the integration of all functions and processes within an organization in order to achieve continuous improvement of the quality of goods and services. The goal is customer satisfaction" (p. 1). The U.S. Department of Defense (Goetsch & Davis, 1997) defined TQM as follows:

> TQM consists of continuous improvement activities involving everyone in the organization – managers and workers – in a totally integrated effort toward improving performance at every level. This improved performance is directed toward satisfying such cross-functional goals as quality, cost, schedule, mission need, and suitability. TQM integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach focused on continuous process improvement. The activities are ultimately focused on increased customer/user satisfaction. (p. 4)

Teegarden (1996) explored the meaning of TQM in detail, and concluded that there was general consensus among practitioners on a short list of essential elements. According to Teegarden (1996), TQM was a true systems-based philosophy that addressed the requirements of "managerial leadership, employee involvement, and management by fact" (p. 15) for ensuring the continued success of the enterprise. From an analysis of the literature, Potocki (1995) synthesized that TQM contained five main elements: continuous improvement practices, customer satisfaction, employee involvement, measurable improvement results, and

leadership. Further, Teegarden (1996) asserted that continuous improvement and customer satisfaction were the two most often cited key ingredients of the TQM management philosophy.

Theoretical Framework Behind Total Quality Management

Numerous management philosophers, statisticians, and business and organizational thinkers have contributed to the body of knowledge associated with the development of the principles of total quality management. Although Japanese companies were the first to adopt a large-scale practice of total quality improvement activities, the field of quality management developed as a science largely due to American contributors. The distinction as the most notable and recognized among all quality pioneers belonged to W. Edwards Deming (1900-1993) (Gabor, 1990). His fourteen-point philosophy for management has been quoted repeatedly in numerous books and journal articles (Deming, 1986). Johnson (1993) provided an updated version of Deming's fourteen-point philosophy, as shown in Table 1.

Although not totally accepted by all TQM practitioners, these fourteen principles of Deming were recognized as major building blocks for strategic quality management. Other important theoretical contributions of Dr. Deming included the theory of profound knowledge and seven deadly diseases of traditional American management (Deming, 1986; Gelina, 1993; Walton, 1986)

Deming pioneered the idea that high quality and high productivity could be achieved simultaneously (Deming, 1986). This was a major paradigm shift for most of American business and industry because managers simply had assumed that good quality could be achieved only by sacrificing productivity and vice-versa. Deming declared that improved

Table 1. Deming's fourteen points (Johnson, 1993, p. 49)

No	Point
1	Create and publish to all employees a statement of the aims and purposes of the company or other organizations. The management must demonstrate constantly their commitment to this statement.
2	Learn the new philosophy, top management and everybody.
3	Understand the purpose of inspection, for improvement of processes and reduction of cost.
4	End the process of awarding business on the basis of price tag alone.
5	Improve constantly and forever the system of production and service.
6	Institute training.
7	Teach and institute leadership.
8	Drive out fear. Create trust. Create climate for innovation.
9	Optimize toward the aims and purposes of the company the efforts of teams, groups, and staff areas.
10	Eliminate exhortations of the work force.
11	a. Eliminate numerical quotas for production. Instead, learn and institute methods for improvement. b. Eliminate MBO (Management by Objectives). Instead, learn the capabilities of processes, and how to improve them.
12	Remove barriers that rob people of pride of ownership.
13	Encourage education and self-improvement for everyone.
14	Take action to accomplish the transformation.

quality actually raised productivity. According to Deming, productivity increased with an increased focus on quality because fewer resources would be required for corrective action. Scrap and wasted resources were also minimized. Improvements in quality did not merely increase productivity; they initiated a chain reaction, as shown in Figure 1. It should be recognized that Figure 1 is a modified version of Deming's original chain reaction (Deming, 1986; Gelina, 1993).

The Deming management method assumed that an organizational system transformed

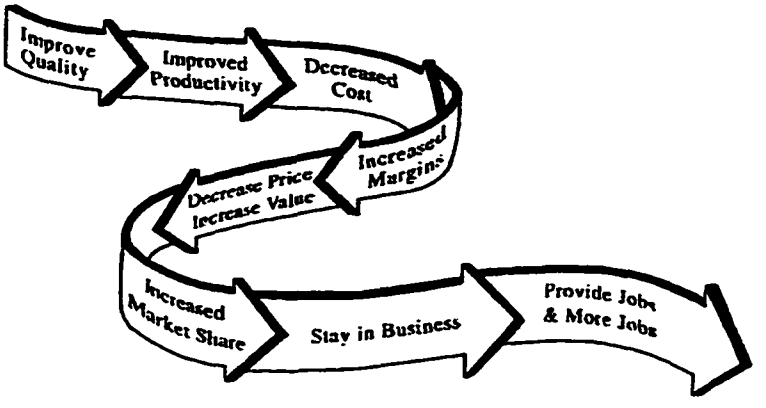


Figure 1. Revised Deming chain reaction (Gelina, 1993, p. 1.10)

inputs into outputs through established processes (Gelina, 1993). This process model is pictured in Figure 2. Inputs thus could be categorized into five major elements. By ensuring that inputs and processes were at the highest level of quality; the outputs produced could be expected to be high-quality products or services. Deming articulated that traditional

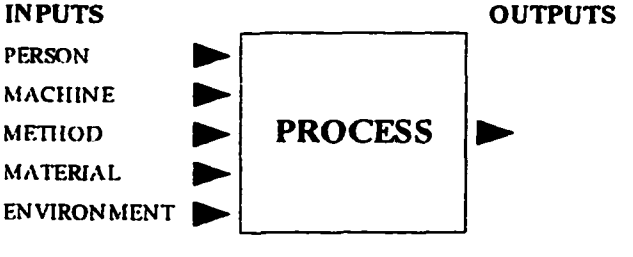


Figure 2. Process model (Gelina, 1993, p. 3.13)

management focused mostly on managing people rather than managing all five categories of inputs. He argued that at least 85% of the problems in the work place were systemic in nature, and that workers were accountable for only 15% (or less) of the problems (Deming, 1986).

Other personalities with significant contributions to the development of modern quality management included Walter Shewhart, Joseph Juran, Philip Crosby, and Armand Feigenbaum, all from the United States (Garvin, 1988). A historical projection of the total quality movement in the United States appears in Table 2 (Goetsch & Davis, 1997).

As more of American business and industry turned to quality as a competitive weapon, interest in the subject has grown. The quality movement in America continued to witness new leaders. Among the newer leaders, popular names were Stephen Covey, Eliyahu Goldratt, and Peter Scholtes. Newer theories, ideas, and published case histories have expanded the field of quality science and management to considerable breadth and depth.

There were quite a few recognized contributors to TQM from other countries. Notable names were Japan's Kauro Ishikawa and Genichi Taguchi. There has been a global-wide unprecedented interest in TQM during the 1980s and 1990s. As quality was based on teamwork and participation of every individual employee of the organization, progressive companies both within the United States and abroad have recognized that quality began and ended with education (Goetsch & Davis, 1997).

Imperatives of Total Quality Management

The phrase TQM became popular in American business circles only during the late 1980s. The emergence of quality as a competitive weapon resulted in a significant interest in

Table 2. Selected historic milestones in the quality movement in the U. S. (Goetsch & Davis, 1997, p. 9)

Year	Milestone
1911	Frederick W. Taylor publishes *The Principles of Scientific Management*, giving birth to such techniques as time and motion studies.
1931	Walter A. Shewhart of Bell Laboratories introduces statistical quality control in his book *Economic Control of Quality of Manufactured Products.*
1940	W. Edwards Deming assists the U. S. Bureau of the Census in applying statistical sampling techniques.
1941	W. Edwards Deming joins the U. S. War Department to teach quality-control techniques.
1950	W. Edwards Deming addresses Japanese scientists, engineers, and corporate executives on the subject of quality.
1951	Joseph M. Juran publishes the *Quality Control Handbook.*
1961	Martin company (later Martin-Marietta) builds a Pershing missile that has zero defects.
1970	Philip Crosby introduces the concept of zero defects.
1979	Philip Crosby publishes *Quality is Free.*
1980	Television documentary If Japan Can.....Why Can't We? airs, giving W. Edwards Deming renewed recognition in the U. S.
1981	Ford Motor Company invites W. Edwards Deming to speak to its top executives, which begins a rocky but productive relationship between the automaker and the quality expert.
1982	W. Edwards Deming publishes *Quality, Productivity, and Competitive Position.*
1984	Philip Crosby publishes *Quality Without Tears: The Art of Hassle-Free Management.*
1987	U. S. Congress creates the Malcolm Baldrige National Quality Awards.
1988	Secretary of Defense Frank Carlucci directs the U. S. Department of Defense to adopt total quality.
1989	Florida Power and Light wins Japan's coveted Deming Prize, the first non-Japanese company to do so.
1993	The total-quality approach is widely taught in U. S. colleges and universities.

the subject and since around 1985, literature addressing quality has been produced at an exponential rate (Bax, 1994). Armand Feigenbaum was the first person to prefix the term quality with the word "total" and explain its significance (Feigenbaum et al., 1988). Total quality implied that the pursuit of quality as a organizational goal depended on the collective

efforts of every individual affiliated with the organization. The interpretation of the word "total" in TQM also implied that quality was judged as a cumulative effect of all characteristics possessed by a product or service. In fact, the nation's leading society dedicated to quality, the American Society for Quality, defined quality as "the totality of the characteristics of a product or service that bears upon its ability to satisfy stated or implied need" (ANSI/ISO/ASQ A8402-1994).

The two common interpretations of the phrase "total" in TQM suggest that there are also two broad essentials embodied in this management philosophy. The first interpretation, based on the fact that TQM involves the active participation of every individual in the organization, suggests that teamwork is an essential element of TQM. The second interpretation, that quality is the totality of all characteristics possessed by a product or service, implies that continuous improvement is also an essential element of TQM.

Gelina (1992) factored the knowledge contained in the Deming management philosophy and statistical process control, and declared teamwork and continuous improvement to be two imperatives to solve problems in total quality managed organizations. Recognizing that low variation was the key to good quality, organizational teams should try continuously to improve their processes to reduce variability (Gelina, 1992). Therefore, any structured training program in TQM should include two elements, that was:

(1) Methods for effective team building.

(2) Methods for continuous improvement of processes.

The topics of teamwork and continuous improvement have been addressed individually in numerous publications that were dedicated solely to these topics. While conducting

research on the wisdom of teams, Katzenbach and Smith (1993) interviewed "hundreds of people on more than 50 different teams in 30 companies and beyond, from Motorola and Hewlett-Packard to Operation Desert Storm and the Girl Scouts" (p. 112). They concluded that teams and good performance were unseparable elements. Likewise, the unique status of continuous improvement was evident in the statement made by Shuster (1994): "management transformation is a management philosophy that inspires and commits every individual to visibly and actively participate in the development, nurturing, and sustaining of a work culture that pursues the ethic of total customer satisfaction through dedication to continuous process performance improvement" (p. 12).

Total Quality Management Process Improvement Models

Gelina (1992) explained that continuous quality improvement could be achieved by blending newer management ideas with the use of statistics. As shown in Figure 3, a model for management was proposed by W. Edwards Deming (1986) (Gelina, 1993). Management knowledge coupled with statistical knowledge and tools enabled the improvement of processes within the organization. The body of knowledge in the management was based on the ideas of two well-known thinkers -W. Edwards Deming and Stephen Covey. The statistical methods were principally based on the ideas of Kauro Ishikawa, Walter Shewhart, and Eliyahu Goldratt. The origin of ideas incorporated in the TQM Process Improvement Model is shown as in Table 3.

Methodologies/models intended for continuous improvement of the quality of products and services have appeared in the literature. However, most of these methods/models lack a rigorous theoretical basis, and the ability to communicate the required

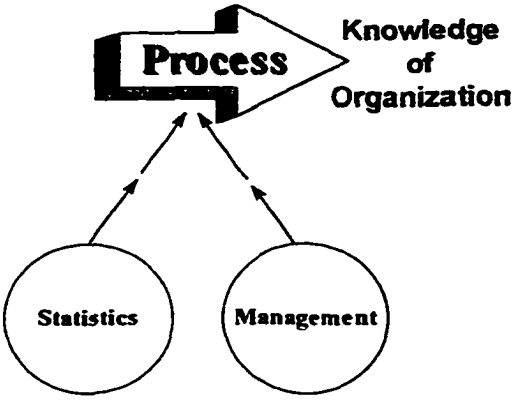


Figure 3. Deming management model (Gelina, 1993, p. 1.7)

steps in a simple, straightforward manner. The TQM process improvement model proposed by Gelina (1993), however, is an exception. This model, shown in Figure 4, provided a easy-to-understand road maps for improving the quality of processes and has been utilized as a visual tool to educate workers at all levels (Johnson & Dugger, 1996).

Table 3. Origin of ideas incorporated in the TQM process improvement model (Gelina, 1993)

Name of Expert	Contribution to the Model
W. Edwards Deming	Fourteen-point philosophy
	Theory of profound knowledge
Stephen Covey	Principle-centered leadership
	Seven habits of highly effective people
Kauro Ishikawa	Basic problem solving tools for process improvement
Walter Shewhart	Control charts to statistically monitor and control processes
Eliyahu Goldratt	Theory of constraints

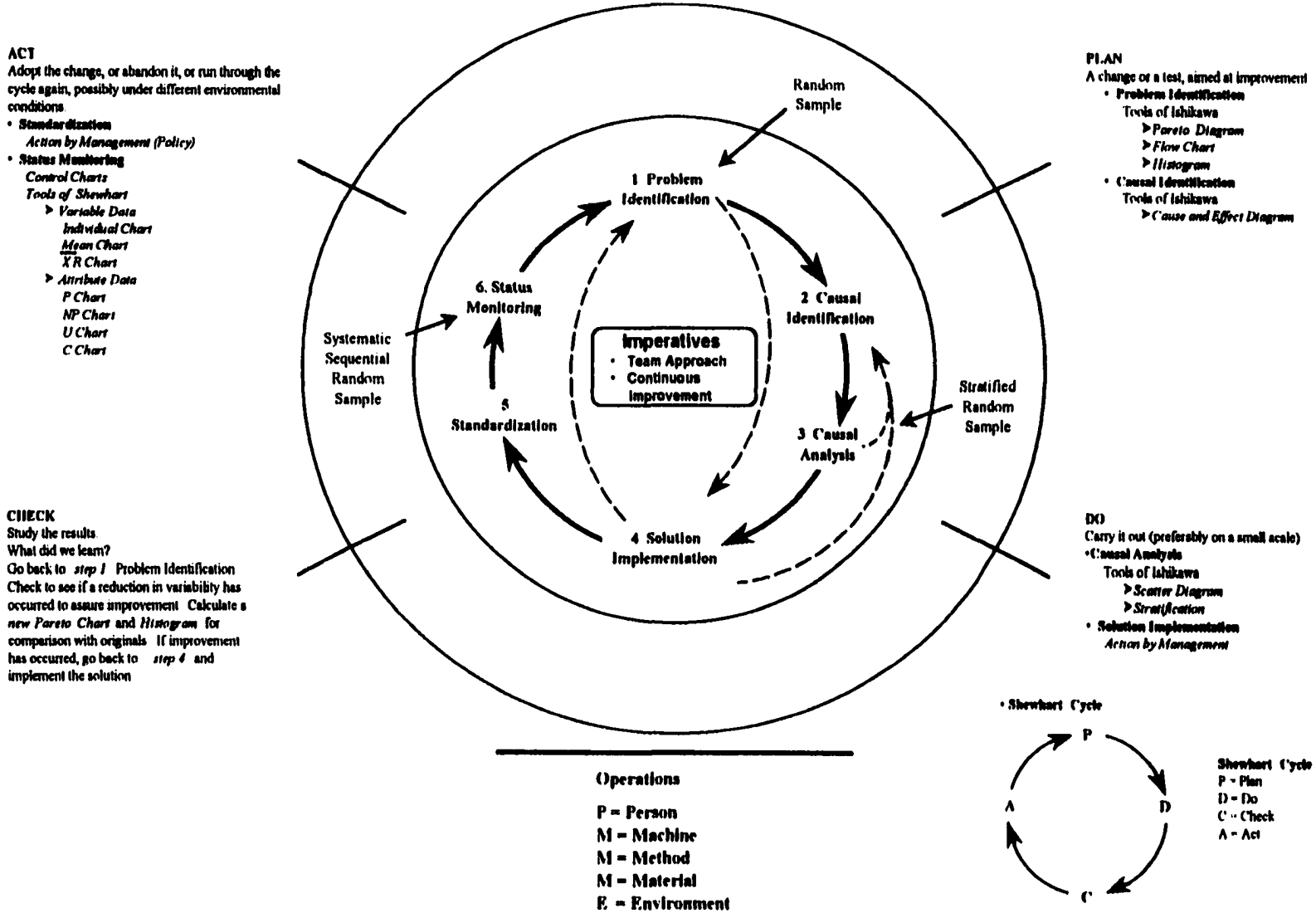


Figure 4. Problem-solving model (Gelina, 1993, p. 3.1)

The TQM process improvement model assumed that continuous improvement and teamwork were imperatives in a modern problem-solving environment. The team approach was a natural prerequisite in today's complex industrial and service environments. Continuous improvement has long been regarded as a staple ingredient of managing for quality (Ehresman, 1995). In fact, Carnevale (1991) noted that continuous learning was the "cornerstone of economic progress" (p. 231).

The model contained five impacting elements: person, machine, material, method, and environment. The term impacting elements had the same meaning as inputs of a process. It was reasoned that the cause of any problems within a process should be embedded in one or more of these five major categories of inputs (Gelina, 1993). An alternate way of categorizing the inputs, in terms of who, where, what, when, and extent, might be appropriate for certain processes.

The functional component of the model involved six stages: problem identification, causal identification, causal analysis, solution implementation, standardization, and status monitoring. These six stages were deemed sequential, but depending on successive outcomes, teams might decide to retrace certain steps. The arrow in the counterclockwise direction implied that problem solving for quality improvement was essentially an iterative process.

Total Quality Management Implementation Strategies

Shiba et al. (1993) identified four revolutions in management thinking that were common in successful TQM implementation. They were:

(1) Focus on customers and satisfying their needs.

(2) Seek never-ending continuous improvement of the processes that lead to higher-quality products and services.

(3) Seek total participation of all people in the company because every individual is ultimately responsible for the quality of the products created by the company.

(4) Participate in societal learning so that quality practices can be implemented more quickly, enabling the company to compete favorably.

Newer management philosophies tend to become more popular when success stories reached members of a wider audience whom were constantly seeking different ways to manage their business enterprise. Success stories have played a major role in the increasing growth of TQM practice in all sectors of the economy. For TQM to bring effective results to any company, the theoretical and practical elements must be integrated (Brocka & Brocka, 1992).

Dingus and Golomski (1988) stated, "a quality process must be adapted to, not adopted by, an organization" (p. 12). This explained the observation that numerous TQM implementation models have appeared in the literature (Brocka & Brocka, 1992). Recently, Teegarden (1996) concluded that transformations to TQM organizations were more likely to be successful if training needs were adapted to meet the needs of individual organizations.

TQM implementation in selected United States-based companies failed because they tried blindly to emulate Japanese strategies. As quality circles (QC) were highlighted as the key factor in the success of Japanese firms, several American companies attempted to initiate a total quality style of management by forming QC circles. As early as 1982, there were

thousands of quality circles in the United States. However, several companies failed to make improvements, mainly because workers received little or no technical training (Hart, 1991).

For successful TQM implementation, experts have identified that it was necessary to practice TQM at four levels within the organization. These were identified as the individual, work group, organization, and industry or regional levels. It was possible to implement practice at all these levels simultaneously (Shiba et al., 1993).

Total Quality Management in American Business Enterprises

The literature contains numerous case studies and success stories of TQM implementation in different sectors. The major result of TQM efforts was customer satisfaction (Saylor, 1992). Further specific organizational victories might be defined by terms such as: survival, more capital for investment, more jobs, higher market share, increased dividends to stockholders, higher profits, increased quality of life, exceptional service, and benefits.

The Baldrige award is the most prestigious honor for quality in the United States. Some of the results achieved by quality-conscious companies are reflected in the success stories of Balridge award winners. The criteria for the Baldrige award are based on the concepts of TQM. Table 4 lists the significant results achieved by selected Baldrige award winners through their TQM initiatives. In 1989, Florida Power and Light Corporation (FPL) became the first American company to win Japan's highest award for quality, the Deming prize. FPL won the Deming prize because of their company-wide total quality management system, called QIP (quality improvement program) (Waylett, 1990).

Table 4. Results achieved by companies by switching to TQM (Saylor, 1992, p. 21)

Name of Company	Results Achieved
Cadillac Motor Company	Reversed its decline in market share. Attracted new buyers while maintaining the highest percentage of repeat buyers in the car industry.
IBM Rochester	Improved productivity by 30 percent. Reduced product development time by more than half.
Federal Express Corporation	Achieved high levels of customer satisfaction. Became world's largest air cargo fleet.
Wallace Company	Increased its sales volume by 69 percent. Increased operating profits 7.4 times.

A study of TQM efforts in manufacturing companies revealed that following tangible benefits were achieved (Hart, 1991):

(1) A 49% reduction in scrap and rework on one line.

(2) A 30% reduction in the cost of quality.

(3) Increased tools life (p. 38).

Besides the tangible benefits, TQM-oriented companies also have cited intangible benefits that included higher employee morale and pride in workmanship.

Total Quality Management in Education

In the early 1990s, the chief executive officers of six major corporations criticized this country's educators, particularly those in higher education, for being too slow in teaching total quality management concepts ("An open letter," 1991; Evans, 1996). Several universities and colleges across the country accepted this challenge, and today most colleges and universities offered courses in TQM (Axland, 1992; Horine et al., 1993; Evans, 1996). Industries such as IBM have offered financial support to U.S. colleges and universities to teach quality management principles to their students and to perform related research (Seymour, 1993).

As universities and colleges began the planning and introduction of TQM-related courses, a large number of these institutions discovered that quality management principles could be applied effectively in their own work settings (Copa, 1993; Corson, 1991; Seymour & Collet, 1991). This realization was not restricted to four-year colleges and universities, but spread to community colleges, vocational institutions, and evens high schools across the nation (Spanbauer, 1992; Needham, 1992). Recent studies confirmed that TQM was a staple course in the higher education curriculum (The Proctor & Gamble Company, 1992).

Even in the United States, where TQM awareness has existed for at least a decade, teaching of the subject matter is still in the beginning stages. A study of the quality curricula and course syllabi in colleges and universities prompted this observation. It appeared that quality management was not well understood by some of the faculty members who taught the subject. This lack of understanding was demonstrated through the deficiency of theoretical base in some of the curricula and syllabi analyzed in this study (Gitlow et al., 1994). This suggests that a TQM program of study should be undertaken with caution and knowledge of what needs to be taught.

Vocational Training Systems Compared - United States versus Taiwan

In the United States, academic institutions are largely responsible for vocational education, that is, training people for entry-level employment. Corporate training programs generally do not address basic training, and are limited in number compared to academic programs at colleges and other educational institutions. Since the Rensselaer Polytechnic Institute initiated the first engineering program in 1824, there has been a consensus in the

United States that there was a strong link between education and training for employment (Miller, 1987).

Four-year colleges, universities, community colleges, and proprietary institutions are largely responsible for preparing people for employment. In addition, in the United States, since the 1970s, a number of consultants and agencies offered training programs that were sought after by small, medium, and large-scale companies (Miller, 1987; Parry & Ouweneel, 1987). If companies require specific training for their employees, there are but few federal or state-sponsored programs. Therefore, vocational training other than that offered at academic institutions is essentially a private enterprise. Also in the United States, there were a number of established professional bodies that played an active role in organizing continuing education for knowledge and development of skills (Goldstein, 1993).

The vocational training system in Taiwan is different from that of the United States in some respects. In Taiwan, distinct vocational training and vocational education systems have been established. Vocational education is administered by the Ministry of Education, whereas vocational training is a function of the Council of Labor Affairs. Thus, training is essentially a public enterprise and vocational training is often referred to as public training (Employment and Vocational Training Administration, 1997).

Vocational Training System in Taiwan

In a broad sense, public training means training that meets the needs of the society at large. In a narrow sense, public training refers to those programs that are conducted at nationally established vocational training centers (Employment and Vocational Training Administration, 1997). The characteristics of public training are:

(1) Participants are not selected; training opportunities are open to the public at large.

(2) Institutional and operational expenditures are borne by the government.

(3) Training expenses are also borne by the government

There are thirteen public vocational training institutions, with a total capacity to train approximately 8,500 individuals at any given time. Figure 5 shows the geographic locations of the thirteen vocational training centers.

Training programs cover 104 trade areas in metal processing, automotive maintenance and repairs, electrical engineering, electronics, computer information, construction, printing, and service industries. The categories of public training provided by the VTCs are as follows:

(1) Pre-employment training: offered for trainers, skilled workers in manufacturing industries, and personnel in service industries.

(2) Upgrading training: provided for instructors, skilled workers in manufacturing industries, and personnel in service industries.

(3) Job transfers training and second expertise training: to individuals who would like to switch careers or would like to add another area of skill to their expertise.

(4) Training for the handicapped: for those individuals with disabilities.

Besides public training, VTCs also offer "enterprise training." The purpose of enterprise training is to:

(1) Assist individual companies in setting up and delivering in-plant-training programs.

(2) Provide and implement in-service training in automation, information technology, and service industries, to mid-level staff management and advanced technicians.

Figure 5. Geographic locations of thirteen vocational training centers in Taiwan (Employment and Vocational Training Administration Handbook, 1997, p. 21)

(3) Offer a channel for the exchange of training ideas, to organize seminars, and to conduct presentations for companies.

(4) Assist companies in importing tax-free training equipment or obtaining tax exemptions or tax deductions for training expenses under certain conditions.

(5) Provide stipends for instructors, teaching material, and printing material for training held by industrial associations, commercial associations, and trade unions (Employment and Vocational Training Administration, 1997).

The qualifications for receiving public training require citizens to be over 15 years of age or a junior high school graduate. Those who are currently employed can sign up for various upgrading, a secondary area of expertise, or job transfer training according to their needs.

Some of VTCs' program offerings are financed by the center, but the training itself is delegated to other institutions such as universities and colleges. One specific example is the mid-level staff management enterprise-training program. However, TQM concepts have not yet been introduced in any of the VTCs' training programs, including the mid-level staff management programs.

Total Quality Management in Taiwan

Overview

As the proposed study focused on perceptions of the feasibility of TQM theories and methodologies in Taiwan's vocational training system, it was relevant to understand the existing status of TQM in Taiwan. It was noted that a significant number of TQM- related articles appeared in Taiwanese publications. The wide range of organizations active in using

TQM methodologies included examples from manufacturing, service, health care, and government (Yang, 1994). Educational institutions were the least active in applying TQM theories (Zhau, 1992).

This study of literature revealed the strong influences of American personalities, theories, and methodologies behind the existing TQM practices in Taiwan. It was also noted that several articles published in Taiwanese journals included references to American research and publications. The articles covered a wide range of subjects ranging from fundamental philosophical issues to applications in manufacturing, service, quality control associations, and the public sector, including the creation of specific computer software programs for quality control. A significant number of organizations in Taiwan have recognized that TQM helps increase product and service quality and improve competitiveness. Therefore, interest in the subject has grown in recent years.

Nearly 97% of Taiwan's industry may be classified as small- and medium-scale enterprises. Even those classified as large-scale industries are much smaller than large industries in other parts of the world (Chen et al., 1996). Compared to American and Japanese enterprises, the introduction and acceptance of TQM in Taiwan's business and industry has been slow (Jang, 1994). The concept of quality circles that originated in America and was practiced in Japan for a long time also became an accepted practice in Taiwan. As early as 1985, a central and satellite development center developed a system of quality circles that integrated selected aspects of Taiwan's culture, thus creating a special quality circle system of their own (Kao, 1995). As of December 1994, there were about 45,070 quality circles involving approximately 360,560 people (Kao, 1995).

Jang (1994) stated that concepts associated with total quality control (TQC) have been around in Taiwanese enterprises for more than twenty years. The ideas of company-wide quality control (CWQC) have been practiced for more than ten years also in enterprises. Jang (1994) also indicated that TQM has already gained acceptance by adding new ideas to the existing TQC and CWQC programs. Also, several companies increased their focus and interest on TQM after obtaining certification to ISO 9000 standards (Jang, 1994).

Even though American and Japanese TQM have become popular in Taiwan's business and industry, it was acknowledged that Taiwan needed to develop its own set of TQM methodologies adapted to meet the specific needs of its culture and society. As Taiwanese corporations had a reasonably good history of managing for quality, it should not be too difficult to meet that challenge (Jang, 1994).

The implementation of TQM needed willingness and strong determination. Correct attitude and common sense were pre-requisites among all employees. In the process of implementing TQM, enterprises have encountered problems due to:

(1) Lack of leadership commitment.

(2) Not enough teamwork spirit in employees.

(3) Employees not have good work behavior.

(4) Not enough faith in continuous improvement.

(5) Leadership lacking sufficient management expertise.

(6) Companies lacking the required enterprise culture.

Yang (1994) cited the examples of two companies that have overcome these problems to integrate TQM successfully in their operations. These two examples were the Chung-Hua Auto Manufacturing Company and the Taishung Enterprise Company.

Theory and Methodology of Total Quality Management

The idea of TQM was recognized as a useful method to change some of the less humanistic practices of the Taylor system of scientific management. TQM provided a more humanistic assumption about employees' human nature and their psychological profiles in an organizational context (Lu, 1996). Deming's fourteen-point philosophy for management was used to assess the effectiveness of Taiwan's hospital system, and the following conclusions were drawn (Hung et al., 1996):

(1) Inter-departmental communication was not effective.

(2) Employees were not happy with the performance appraisal system.

(3) Lack of education and training.

(4) Poor quality control.

Li (1997) observed that more and more organizations in Taiwan were understanding the theory of teams. Teams offered an effective way to communicate across organizational boundaries to solve problems, to gain employee commitment, and to respond quickly to environmental changes. Therefore, more organizations in Taiwan were in the process of increasing the use of teams to accomplish their goals (Li, 1997).

Total Quality Management Implementation Strategies

Chen et al. (1996) proposed a planning reference model for TQM of central and satellite production's system. An IDEF (ICAM DEFinition Method) originally proposed by the United States Air Force was incorporated in the formulation of the central and satellite production's system TQM model (Busby & Williams, 1993; Kusiak & Dorf, 1994). In this model, the central and satellite factories could co-operate under the same ideal to achieve the goals of total quality optimization and maximization of benefits.

A structured approach presented as a model for the implementation of TQM was developed by Pan (1993). The Malcolm Baldrige quality award criteria provided the theoretical basis for the development of this model. In this approach, a flowchart provided a view of TQM concepts, strategies, and tools. In contrast with TQM's concepts, strategies, and tools, the seven categories of Malcolm Baldrige Award criteria have been superimposed on the Plan/Do/Check/Act phases as shown in Figure 6. This model could serve as a self-assessment tool to evaluate the progress of TQM implementation (Pan, 1993).

Application in Business and Industry

There has been a steady interest in Taiwan's companies regarding efforts to improve quality of products and services, and to become more competitive in the world market (Cheng et al., 1996). Companies had recognized that implementing TQM concepts such as statistical process control could offer the following benefits:

(1) Implementing a reasonable quality control system.

(2) Increasing problem-solving ability.

(3) Improving quality of products and services.

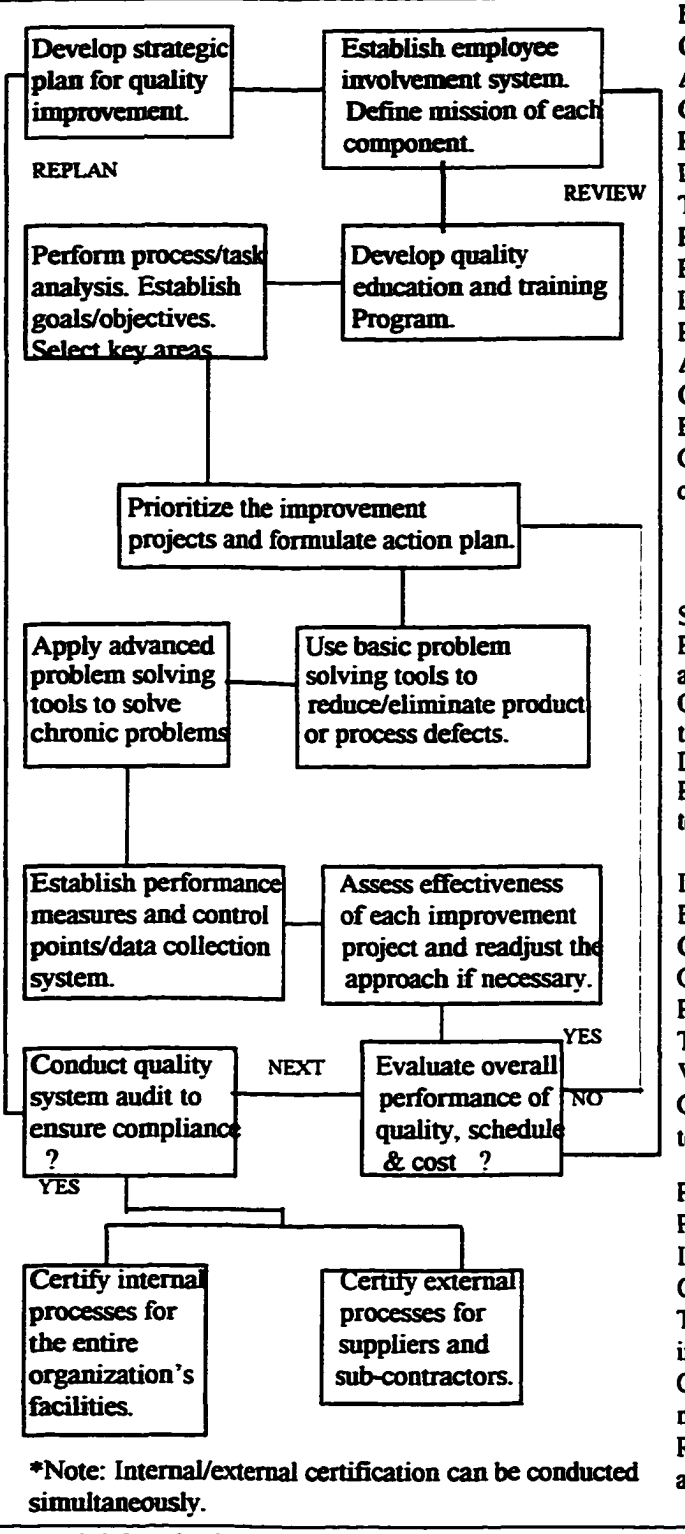
TQM's key elements - continuous improvement concepts	TQM's strategies -An implementation model and steps	Effective TQM's tools and techniques
I. Plan: Strategic planning for quality improvement systems, organization structure; Employee empowerment and teamwork; Quality education & training; Supplier involvement & training. Baldrige examination category: Leadership; Strategic quality planning; Human resource utilization; Customer satisfaction.		Brainstorming techniques; Cost of quality assessment; Analysis and planning tree; Cost reduction opportunity; Process flow analysis; Decision-making theory; Team building; Project management; Principles of learning; Lesson plan/Teaching aids; Pareto analysis/diagram; Affinity diagram; Concurrent engineering; Benchmarking; Quality function deployment (QFD).
II. Do: Effective TQM tools and techniques. Baldrige examination category: Quality assurance of products and services; Customer satisfaction.		SPC seven tools; Product and process flow analysis; Quality engineering techniques; Design of experiments; Reliability engineering techniques. FIA, FMEA.
III. Check: TQM results and measurement; Performance evaluation; Quality system audits. Baldrige examination category: Quality information and analysis; Customer satisfaction.		Input/output analysis; Benchmarking; Cost of quality assessment; Quality loss function; Process capability study; Trend analysis; Value engineering; Quality auditing/survey techniques.
IV. Act: Internal/external certification; Continuous process improvement; Supplier improvement. Baldrige examination category: Supplier quality improvement; Customer satisfaction.	*Note: Internal/external certification can be conducted simultaneously.	Periodic customer survey; Periodic supplier survey; Industrial modernization; Corrective action teams; TQM/JIT system integration; Crisis and time management; Resource and capacity assessment.

Figure 6. A structured model for the implementation of TQM (Pan, 1993, p. 182)

(4) Increasing revenue from sales and profits (Cheng et al., 1996)

Chau (1992) conducted a study in a food processing company about the effectiveness of quality circles. The treatment group participated in a quality circle, where as the control group did not participate in a quality circle. This study revealed significant differences in terms of employee job variety, task identity, and role ambiguity. However, there were no differences in attitude toward work and job performance.

One of the nation's large steel manufacturers, China Steel Corporation, has been actively implementing statistical process control techniques since December 1992 (Cheng et al., 1996). Other industries have observed that automation of manufacturing quality control systems not only enabled reducing manpower, but also increased productivity and quality (Chai, 1995). Expert systems in quality monitoring and diagnosis were also practiced by some industries. The result was to help the quality control personnel and process planning engineers manipulate their jobs more economically and efficiently (Chiu, 1994/95).

Application in Education and Public Sector

The quality movement in education in the United States received attention in Taiwan (Zhau, 1992). It was noted that several American universities, community colleges, and research institutions implemented TQM initiatives by offering courses, performing research, providing training, and using a TQM philosophy to manage the educational institution themselves. It was also noted that the American Society for Engineering Education (ASEE) was considering the establishment of a TQM award for engineering education using the Malcolm Baldrige award criteria (Zhau, 1992). Based on these findings, Zhau (1992) proposed that educational institutions in Taiwan should seriously consider the application of

TQM initiatives. Also, the uses of computer software to perform quality control analyses such as acceptance sampling and process control have gained wide acceptance in quality education (Yei, 1995).

Halachmi (1996) observed that TQM was making its way into the public sector in Taiwan. It has been noted that an understanding of human ecology was necessary to implement TQM successfully in the public sector. Specifically, reforms in training methods and performance appraisal approaches were required. The opportunity to learn from the experiences of the private sector has also been recognized (Li, 1996). The external environment was more unpredictable and more influential in the public sector. Organizational culture was more difficult to change, as governmental activities were older, with more ingrained cultural elements. Therefore, TQM methodologies for the public sector must be particularly good at addressing individual differences in organizational culture.

Status of Research in Total Quality Management

Ross (1995) noted that it was widely agreed that quality of products and services has become a prerequisite for companies desiring to capture newer markets and retaining existing ones. Therefore, interest in and acceptance of TQM has accelerated around the world, and along with this came-increased research and related reports. More recently, TQM literature and dissemination of related research has become abundant in the United States. However, in the past, significant contributions have come from research work completed in other countries, primarily Japan.

A majority of the published research work during the 1980s was of Japanese origin. Shiba et al. (1993) stated that between 1960 and 1985, about half of all quality control books

were publications of the Union of Japanese Scientists and Engineers (JUSE) or the Japanese Standards Association (JSA). JUSE and JSA continued to conduct extensive research in the development of new quality methods. Specifically, even during the beginning stages of the quality movement in Japan, JUSE set up the QC Research Group, and JSA established the QC Research Committee. Meetings within these groups often provided the opportunities to develop new methods for improving quality. Shiba et al. (1993) noted that although it was normal for these research groups to plan meetings that lasted one or two hours only, informal discussions would continue "into the wee hours of the morning" (p. 519).

A total quality research (TQR) system based on Deming's systems approach to quality was proposed by Hurley and Laitamaki (1995). Accordingly, TQR could be defined as a system that provided reliable and valid market, employee, and business process information that improved strategic decisions in order to provide competitive value for customers. TQR had the potential to guide a firm's TQM efforts by acting as both an internal and external information processes, which in turn enabled strategic planning. This way of thinking was quite similar to the concept of the highly evolved quality function deployment methodology.

TQM research focused largely on management and related methods or techniques (Dean, 1995). However, it rarely addressed the scope demonstrated by Monden (1993). In addition to addressing management and management technique, the literature of TQC incorporated the totality of integrated product and process development or IPPD, which incorporated engineering process. Dean (1995) further concluded that American TQM, in the large, was at the stage of a fuzzy perception of what quality really was. It had an even fuzzier perception of how and where to implement it. Morup (1992) noted that compared with other

methods, DFQ [Design for Quality] in the hands of total quality management has suffered from a lack of theoretical basis and limited insight into the nature of design. TQC, on the other hand, has defined quality rather rigorously and moved on into rigorous implementation. From the perspective of competitive advantage, the first challenge for TQM was to holistically define the nature of quality and then rigorously implement a form of IPPD, which would attain the defined quality. The second challenge was to move beyond. Until it moved beyond, TQM would not have the competitive advantage (Dean, 1995).

A big step toward promoting TQM research occurred in the United States during 1991 when the chairpersons of six sponsoring corporations of the Total Quality Forum, an annual gathering of academic leadership called for closer cooperation between universities and corporations to promote total quality management ("An open letter," 1991). The six individuals were James D. Robinson III of American Express, John F. Akers of IBM Corporation, Edwin L. Artzt of Procter & Gamble, Harold A. Poling of Ford Motor, Robert W. Galvin of Motorola, and Paul A. Allaire of Xerox. This open letter specifically urged universities to encourage research and teaching of TQM principles on American campuses.

Carnegie Mellon entered into a TQM partnership with Xerox Corporation, and sent 140 faculty and staff members, including 40 from GSIA (Graduate School of Industrial Administration), to the Xerox headquarters in Rochester, N.Y., to study the strengths and weaknesses of both organizations. GSIA has since integrated a modified version of the Xerox TQM program into the curriculum and established TQM practices in the school's administration. Nearly all faculty and staff -- as well as groups of volunteer GSIA students -- have been through TQM training, with the result that GSIA was on a track of continuous

quality improvement for the future. All new staff members underwent TQM training and plans were underway to expand student training with an experimental series of weekly three-hour TQM sessions. As part of GSIA's TQM program, they have also created Staff Recognition Awards that recognized years of service and merit achievement. Now in its fourth year, the awards inspired the staff to participate in the effort to make constant improvement a major goal of all job responsibilities (The Procter & Gamble Company, 1992, p. 5-2).

CHAPTER 3. METHODOLOGY

This chapter describes the methods and procedures used in conducting the study. This chapter is divided into the following sections: Population and Sample of the Study; Research Design and Variables of the Study; Development of Survey Instrument; Data Collection Procedure; and Statistical Analysis of the Data.

Population and Sample of the Study

The survey participants included the instructors of thirteen vocational training centers of Taiwan and leaders from companies that have sent their employees to vocational training centers. There were approximately 500 instructors in the thirteen vocational training centers (centers were selected as an entire population). This included Assistant, Associate, and Full instructors (Employment and Vocational Training Administration, 1997).

Recognizing that companies' leaders included President, Vice President, and Manager, the leaders identified in the approximately 150 companies (companies were selected as a purposive non-random sample) numbered around 450 (Ministry of Economic Affairs, 1997). This selection criterion was based on the researcher's literature review, which indicated that those companies found it economically unfeasible to offer their own training programs due to the cost of materials and personnel resources.

Research Design and Variables of the Study

A descriptive study was used to collect and analyze the data to determine the perceptions of the feasibility of TQM theories and methodologies in the vocational training

systems as perceived by the centers' instructors and the leaders of companies. The dependent variables were: (1) the degree of importance of teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the VTCs; (2) the level of preferences for potential learning opportunity to improve instructors' knowledge of TQM principles and methods; and (3) the degree of agreement with strategies that might be used to include TQM practices into the VTCs' curriculum. The independent variables are listed in Table 5.

Development of Survey Instrument

The procedure used to complete this study required the development of a paper and pencil instrument that would specifically address the research questions and hypotheses and serve as a tool for data collection. This section describes the process used in the development of the instrument and pilot testing.

Overview of the Instrument Development Process

The development of the instrument was an iterative process. Previously developed questionnaires and research findings in related studies were closely examined to verify if appropriate models for the proposed instrument could be identified.

In 1991, two hundred academic and industry leaders conducted a joint session to identify ways to accelerate the teaching, research, and practice of total quality in the United States (The Procter & Gamble Company, 1992). An important outcome of this meeting was the formation of a Total Quality Leadership Steering Committee and the formation of working councils to address crucial TQM areas. The Leadership Steering Committee released a

Table 5. Independent variables of the study

Independent Variables
Job titles of the centers' instructors
Job titles of the companies' leaders
Levels of education of the centers' instructors
Levels of education of the companies' leaders
Years of working experiences of the centers' instructor
Years of working experiences of the companies' leaders
Hours of training of TQM of the centers' instructors
Hours of training of TQM of the companies' leaders
Location of the training centers
Type of training programs at the centers
Type of sponsoring agency of the centers
Number of students at the centers
Location of the companies
Type of products at the companies
Type of ownership category of the companies
Number of employees at the companies

publication, titled "A Report of The Total Quality Leadership Steering Committee and Working Councils" (The Procter & Gamble Company, 1992). This report contained a section exclusively addressing the needs of industry in relation to the methodologies and principles of TQM that should be incorporated into business, engineering, and related other curriculum.

The Leadership Steering Committee's membership involved CEOs of leading corporations and educators from highly reputed institutions. Table 6 contains a listing of the names and affiliations of the members of the Steering Committee. The findings of this report

Table 6. Leadership steering committee membership (The Procter & Gamble Company, 1992)

John F. Akers	Chairman of the Board, IBM
Paul A. Allaire	Chairman and CEO, Xerox Corporation
Edwin L. Artzt	Chairman of the Board and Chief Executive, The Procter & Gamble Company
John V. Byrne	President, Oregon State University
Livio D.DeSimone	Chairman of the Board and CEO, 3M Corporation
Meyer Feldberg	Dean, Graduate School of Business, Columbia University
Christopher B. Galvin	Senior Executive Vice President and Assistant Chief Operating Officer, Motorola, Inc.
Roger Milliken	Chairman and CEO, Milliken & Company
C. Warren Neel	Dean, College of Business Administration, University of Tennessee at Knoxville
John E. Pepper	President, The Procter & Gamble Company
Frank H. T. Rhodes	President, Cornell University
James D. Robinson III	Chairman and CEO, American Express Company
William R. Showalter	Dean, School of Engineering, University of Illinois
Donna E. Shalala	Chancellor, University of Wisconsin at Madison
Robert C. Stempel	Chairman, General Motors Corporation
Charles M. Vest	President, Massachusetts Institute of Technology
John A. White	Dean of Engineering, Georgia Institute of Technology
B. Joseph White	Dean. School of Business Administration, University of Michigan

have played a significant role in research related to TQM education in the United States during the 1990s (Evans, 1996; Weinstein et al., 1998).

Core Body of Knowledge of Total Quality Management

The Leadership Steering Committee selected a number of private and public sector employers with established reputations for practicing total quality principles in their organizations, for a study addressing TQM preparedness of college/university graduates. The data collected about the needs and expectations of employers with respect to TQM revealed a

pattern of eight clusters of orientation and knowledge. These clusters were identified and described as shown in Table 7.

The eight clusters identified in the Leadership Steering Committee's report have also formed the basis for more recent studies in total quality education (Evans, 1996; Weinstein et al., 1998). All eight factors described as clusters were assumed to be of equal importance. This observation of eight clusters was identified as the best available model for writing an initial set of items (1-48) that would answer specifically TQM content-related research questions posed in this study.

Instructor Preferences for Total Quality Management Learning Opportunities

A Faculty Development Working Council established as part of the Leadership Steering Committee conducted a significant study in exploring and proposing actions to promote the mastery of TQM principles among faculty of colleges and universities based in the United States. A survey-based study of more than 976 deans of schools revealed their perceptions on ten different options for developing faculties' interests and skills to teach total quality. Brief descriptions of these ten alternatives were as follows:

(1) Industry executive on loan: A senior executive with significant TQM experience in the industry would work on-site with a college or university for a period of six to twelve months to provide education on TQM to the faculty, as well as providing on-going consulting as TQM approaches are integrated into the curriculum (ITEM 49).

(2) Senior faculty member (TQM expert) on loan: A senior faculty member from a college or university who has knowledge and experience with TQM would work with a college or university for six to twelve months to provide TQM education to faculty

Table 7. Factors defining total quality orientation and knowledge (The Procter & Gamble Company, 1992, p. 3-5)

Cluster	Description
Customer orientation (ITEM 1-6)	Customers- their needs and our solutions to their problems-are why organizations exist; all employees must continually strive to improve satisfaction
Practical knowledge and application of TQM tools (ITEM 7-12)	Hands-on skill in using Total Quality processes and tools within a business context
Fact-based decision making (ITEM 13-18)	The need for the right data at the right time for the right action; asking "What do I need to know?" and "How will I act on the information?"
Understanding of work as a process (ITEM 19-24)	Work is a process organized around outcomes; as a process, work can be improved and refined-even radically overhauled-to achieve improvement
Team orientation (ITEM 25-30)	Ability to work effectively with others; minimize unproductive conflict while encouraging diverse opinions and constructive debate; valuing the greater good of the company above personal, unit, or functional goals
Commitment to improvement (ITEM 31-36)	Continuously striving for improvement, from the small and incremental to the big breakthroughs
Active learner (ITEM 37-41)	Learning is central to success; ability to gain insight by reflecting on successes and failures; to learn from co-workers, competitors, and customers
Systems perspective (42-47)	Ability to see the "the big picture," across hierarchical, organizational, and functional boundaries

and on going consulting as TQM is integrated into the curriculum (ITEM 50).

(3) Faculty internships: Faculty members would spend from one to four months at a leading corporation that applies TQM in its operations, or at an appropriate college/university where TQM has been effectively integrated into the training

curriculum (ITEM 51).

(4) Teleconferences: Faculty members would be exposed to a series of (3-5) two-hour broadcasts aimed at establishing a basic awareness of TQM and its potential from a national economic viewpoint (ITEM 52).

(5) TQM Institute: Faculty members would attend a one-week session sponsored by professional bodies and conducted by highly reputed universities. The objective of this institute would be to build awareness of TQM concepts, identify research issues, and expose faculty to alternate approaches for introducing TQM into the curriculum (ITEM 53).

(6) TQM partnerships: A critical mass of faculty (35%-75%) from schools would visit a company for four to five days to learn about TQM. Faculty would interact with company employees in factory settings, examine case studies, and visit different sites that belong to the company (ITEM 54).

(7) Conferences: Faculty members would participate in 200-800 conferences sponsored by higher education organizations, TQM organizations, and business associations. Conferences generally would include presentations on latest information, roundtable discussions, and exhibition of products and services related to TQM (ITEM 55).

(8) TQM education: Faculty members would attend a two- or three-day TQM course on campus (about 25 participants per course) that is similar to programs provided by TQM-oriented companies for their own employees (ITEM 56).

(9) TQM workshops: Sponsored by academic accreditation bodies, these workshops

would focus on issues of importance in implementing TQM throughout the curriculum. Specific issues such as strategic planning, processes to improve faculty performance, approaches to measuring performance, emerging curriculum topics, and benchmarking would be included (ITEM 57).

(10) TQM resource guide: Involves creating a document containing TQM course outlines, materials, reading, and teaching notes that represent best approaches (ITEM 58).

One limitation of the survey conducted by the Faculty Development Working Council was that perception of the effectiveness of learning opportunities was gathered from deans rather than faculty members. However, the questionnaire developed in this study was considered an appropriate model for proposing an initial set of items (49-58) that addressed instructor preferences for TQM learning experiences in the vocational training centers of Taiwan.

Strategies for Including Total Quality Management in the Curriculum

The importance of a basic strategy and processes that were needed to initiate TQM concepts into the curriculum have been studied by The Total Quality Curricula, Materials and Programs Working Council. A ten-member panel of experts representing United States industry and academia studied 38 universities who have been active in incorporating total quality concepts into their curriculum. These institutions were asked to share their experiences in introducing TQM in their curriculum.

The study of the 38 universities revealed that although few programs have fully integrated TQM into their curriculum, there was significant commitment and progress within a

short period of time. It was also clear that no single approach could be the best answer to achieve TQM integration into the curriculum. In fact, several different approaches could yield satisfactory results. For example, some universities preferred to designate specific courses to teach TQM principles to students, whereas other institutions preferred to include TQM concepts in several courses spread throughout the student's educational experience. Another example of variation was that some universities preferred to bring faculty from various departments together for teaching TQM using a team approach, whereas others preferred to let individual faculty determine what needed to be taught and to do it on their own.

Even though several variations existed in the approaches of the different institutions, the members of the panel were able to identify six strategies that were usually present in case studies of successful introduction of TQM into an institutions' curriculum:

(1) Integration of TQM content within individual courses as well as the entire curriculum (ITEM 59-60).

(2) Practicing quality management principles in the operations of the academic institution itself (ITEM 61-62).

(3) Establishing and maintaining a customer-focus in all activities of the institution (ITEM 63-64).

(4) Involvement of stakeholders in curriculum decisions (ITEM 65).

(5) Commitment of the top management and leadership of the academic institution (ITEM 66).

(6) Creating processes for anticipating and responding to future requirements of industry (ITEM 67).

These common factors identified in the study provided the basis for writing items (59-67) that addressed basic strategies to incorporate TQM in the vocational training centers' curriculum.

Experts Review

The proposed developed instrument containing 67 items was supplied to a panel of knowledgeable members for reviewing to establish the content validity. The names and affiliations of all the members included in this panel are provided in Appendix A. As seen from this list, the background of the panel of instrument validators was diverse and included university professors, community college educators, and industry personnel. Certain members also possessed specific knowledge of Chinese culture; therefore, they were able to analyze the instrument from the perspective of conducting this study in Taiwan, R. O. C. As a result of feedback from this panel of experts, some minor modifications were necessary.

The revised version of the instrument that the panel of experts modified was titled "Total Quality Management Feasibility Instrument" and contained a total of sixty-seven items to measure the three major constructs (scales) of core body of knowledge of Total Quality Management, instructor preferences for Total Quality Management Learning Opportunities, and strategies for including Total Quality Management in the curriculum. Eight items addressing personal information were also included.

Chinese Translation of the Instrument

A Chinese version of the English instrument proved necessary as it was recognized that a large number of instructors at the vocational training centers and leaders of companies would prefer that the survey instrument be in the Chinese language. A translation from English to Chinese was completed and submitted to national TQM experts: Professor Wang,

M. J. (National Taiwan University) and Professor Tai, J. Y. (National Jeo-Tung University) for verification. This was particularly important as the survey contained specific TQM terminology, and it was necessary to account for variations in the use of common terminology that existed between the people of the United States and Taiwan, R.O.C.

Although the Chinese translation was completed, it was decided to use a bilingual format in the actual instrument that would be employed for data collection. Both English and Chinese language would appear in the first-construct items (1-48) of the instrument. This version of the instrument is shown in Appendix B.

Pilot Testing

Pilot studies were strongly recommended before employing survey instruments that addressed research problems (Isaac & Michael, 1995). The major purpose of the pilot test was to verify the readability and clarity of the instrument. It was also intended to use the pilot test data as a basis to perform statistical analyses and find out if any problems arose in this regard. The twenty students for pilot testing were enrolled in a graduate program in National Normal Chang-Hua University. A cover letter as shown in Appendix C was prepared to provide pilot test subjects with necessary background and information for this part of the study. Further, a company manager based in Taiwan was asked to examine the instrument and offer comments.

All subjects agreed that the entire instrument was clear and easy to understand. The descriptive statistics for the data obtained from pilot testing were compiled to assess the reliability of the instrument. The results of the pilot test as reflected by the Cronbach coefficient alpha appear in Table 8. The results of the pilot test suggested that no

Table 8. Cronbach coefficient alpha of the instrument from pilot test

Cronbach coefficient alpha of the instrument from pilot test	
for Raw Variables	0.944367
for Standardized Variables	0.944084

modifications to the preliminary instrument were necessary and it is retained as the final instrument shown in Appendix D.

Human Subjects Review

Before actual data collection began, it was necessary to obtain permission from the Human Subjects Review Committee of Iowa State University's graduate college. As part of obtaining this permit, a letter was obtained from the Director-General of Employment and Vocational Training Administration of the Council of Labor Affairs from Taiwan, R.O.C.. This letter, as shown in Appendix E, confirmed that it was possible to collect data from instructors at the thirteen vocational training centers in Taiwan, R.O.C.. The Human Subjects Review Committee approved the study and a copy of the formal letter granting this permission is provided in Appendix F.

Data Collection Procedure

This section describes the process involved in collecting the perceptions of the subjects from instructors at the vocational training centers and leaders at companies based on the developed instrument. The administration of the survey instrument, the method of input solicited of the respondents, and the sample breakdown are considered.

Administration of the Survey and Response Input

A cover letter, as shown in Appendix G, was prepared to communicate the objectives of the study, and basic instructions regarding anonymity of individual respondents and confidentiality of the individual responses were provided between the researcher and the respondents. The data collection was completed during a three-month period starting from July 9, 1998 and ending on September 7, 1998. Five hundred copies of the instrument were mailed to reach every instructor teaching at the thirteen vocational training centers. The directors of the thirteen vocational training centers co-operated actively during the data collection process. Surveys were mailed directly to the office of the director at these centers, and these then were forwarded to the instructors. Also, one hundred and fifty companies that have sent their employees to any of the thirteen vocational training centers for training received three copies each of the instrument.

Surveys mailed to companies' leaders were identified with a code in order to facilitate identification of the need for follow-up mailing and increase the response rate. Telephone calls were made to establish contacts with companies' leaders that did not respond to the first request. Sometimes, actual contacts were made and opportunities to talk with companies' leaders arose. Several repeated attempts were made via the telephone to mention the importance of the study and explain the content of the questionnaire. Follow-up mailings were completed one month after the initial mailing. A separate cover letter was designed for use during this follow-up phase and a copy of this letter appears in Appendix H. The companies and centers were provided with a self-addressed postage-paid envelope to return

the surveys directly. Follow-up efforts ceased when it appeared that no more surveys would be returned.

Sample Breakdown and Response Rate

Table 9 provides a summary of the number of instructors who answered the survey at thirteen vocational training centers as compared to the greatest number of respondents who were expected to be present.

The number of surveys returned from companies' leaders was 95 out of the original 450 that were mailed. This corresponds to a response rate of approximately 21%. Only one response was obtained from each company even through responses from three different individuals were sought from each company. So, 95 out of the 150 companies that received

Table 9. Number of respondents from the VTCs surveyed

Name of the VTCs	No. expected	Actual no.	Response rate (%)
Taishan VTC	41	33	80.5
Northern VTC	48	28	58.3
Central VTC	118	94	79.7
Southern VTC	48	42	87.5
Youth VTC	34	18	52.9
VTC for Retired Servicemen	14	14	100.0
VTC for Fishery Staff & Sailors	7	7	100.0
Northern VTC of Labor Dept.	25	10	40.0
Southern VTC of Labor Dept.	46	40	86.9
VTC of Taipei Labor Bureau	85	36	42.4
VTC of Kaohsiung Labor Bureau	20	9	45.0
VTC of Culture & Welfare Foundation	20	14	70.0
Eastern VTC	20	20	100.0
Total	526	365	69.4

the surveys were represented in the participating sample. This corresponds to a response rate of approximately 63% of all companies.

Statistical Analysis of Data

This section describes the item analysis, reliability of the instrument, tests of hypotheses, and exploratory factor analyses.

Item Analysis and Reliability of the Instrument

To identify individual items indicating high and low importance, the items were ordered by the means and standard deviations obtained on the 444 respondents. The highest 10 and lowest 10 were listed to help the VTCs' instructors and companies' leaders identify the three scales (Core body of knowledge of TQM, Instructor preferences for TQM learning opportunities, Strategies for including TQM into curriculum) considered most important or desirable as well as to examine areas which might be more difficult to attain. The reliability analysis was conducted for each of these three major scales assumed in formulating the instrument.

Tests of Hypotheses (1 - 8)

To test the hypotheses that the scales 1 (core body of knowledge of TQM), scale 2 (instructor preferences for TQM learning opportunities), and scale 3 (strategies for including TQM in the curriculum) had equal means for groups defined by job titles, levels of education, years of working experiences, hours of training of TQM of the VTCs' instructors, location, type of training programs, type of sponsoring agency, and number of students at the centers, one-way analyses of variance were conducted at the 95% confidence level. Thus, there were eight ANOVAs completed for each of three scales. These analyses were all performed on the

sample of responses obtained from the VTCs' instructors. Scheffe' post-hoc comparisons among groups were also performed at the 95% confidence level in order to determine which, if any, simple contrasts among groups were significant.

Tests of Hypotheses (9-16)

To test the hypotheses that the scales 1 (core body of knowledge of TQM), scales 2 (instructor preferences for TQM learning opportunities), and scales 3 (strategies for Including TQM in the curriculum) had equal means for groups defined by job titles, levels of education, years of working experiences, hours of training of TQM of the companies' leaders, location, type of products, type of ownership category, and number of employees of the companies, one-way analyses of variance were conducted at the 95% confidence level. Thus, there were eight ANOVAs completed for each of three scales. These analyses were all performed on the sample of responses obtained from the companies' leaders. Scheffe' post-hoc comparisons among groups were also performed at the 95% confidence level in order to determine which, if any, simple contrasts among groups were significant.

Tests of Hypotheses (17-19)

Hypotheses 17-19 examined the hypotheses of equal means for populations sampled from VTCs and companies on each of three scales of the instrument. To complete these analyses, a single multivariate analysis of covariance was performed with the inclusion of three separate analyses of covariance. The multivariate test was for the equality of centroids defined by the scales 1 through 3. The F-test estimate from Wilk's Lambda statistic was

utilized at the 95% confidence level. The F-test was also utilized for the three separate analyses of covariance for test of equality of the scale means. In both the multivariate and univariate analyses, the covariates selected were demographic data common to both VTCs' and companies' respondents. These were:

(1) Levels of education;

(2) Years of working experiences;

(3) Hours of training of TQM; and

(4) Size of organization as measured by number of students or number of employees.

Exploratory Factor Analyses

To examine the validity of the three scales as measures of different perceptions of the feasibility of TQM training at VTCs in Taiwan, R.O.C., several analyses were performed. A Principal Axis Factor Analysis (Common Factor Analysis Model) was completed using the SPSS for Windows package. Communalities were estimated initially by squared multiple correlations of each item in the instrument with the remaining items. Factors corresponding to eigenvalues of 1.0 or greater were rotated with the Varimax criterion. Examination of the resulting factors in terms of their relationships to the three scales was performed by ordering items based on the size of the factor loadings on the items and examining the content of the items loading on each factor and the primary scale or scales from which they were obtained.

Attempts were made to label each factor by the predominant communality of the content of those items on a factor. By this means the researcher hoped to identify key concept clusters that might explain differences observable among subgroups with VTCs or companies

as well as differences that might be observed between VTCs' instructors and companies' leaders.

Pearson Product-Moment correlation were computed and tested with a two-tailed t-test at the 95% confidence level among three scales and nine factors scores of the instrument, and the ordinal measures of levels of education, years of working experiences, hours of training of TQM and size of organization (number of students or number of employees). In particular, the researcher desired to demonstrate that the nine factor scores obtained by linear regression means were, in fact, correlated near zero as they should be if orthogonal factors were obtained. In addition, it was desired to know the degree of relationship among the three scales as well as among the factor scores. The latter provided additional information for labeling the factors and validating the constructs of the original three scales of the instrument.

CHAPTER 4. RESEARCH RESULTS AND FINDINGS

The results of the data analysis and research findings are presented in this chapter. It is organized sequentially into sections as follows: (a) demographic characteristics of respondents; (b) item analysis; (c) reliability of the instrument; (d) assumptions of statistical analysis; (e) tests of hypotheses; and (f) exploratory factor analysis.

Demographic Characteristics of Respondents

This section provides the descriptive statistics associated with the independent variables based on respondents gathered through the administration of the instrument. The population of interest in this study was the centers' instructors and companies' leaders, which had sent their employees to the centers in Taiwan, R.O.C. Participants who completed the instrument numbered 365 from VTCs and 95 from companies. Invariably in a large data collection situation, there were respondents who could be considered as outliers or individuals that did not follow directions or attend to the task with seriousness. One method commonly used was to examine the responses of individuals for a response set, that is, a pattern of responding which appeared inappropriate for the instrument. If an individual marked all items the same (for example, 7 to each item), they were suspect and eliminated. A total of 16 subjects from this original pool of respondents (365 VTCs' instructors and 95 companies' leaders) were thus eliminated, leaving a total sample of 444 observations. Therefore, the analysis included 351 VTCs' instructors and 93 companies' leaders. The distribution of the independent variables for the VTCs' instructors and for the companies' leaders is indicated in Table 10 and Table 11.

Table 10. Distribution of independent variables for VTCs' instructors

Independent variables	Number & percentage of total instructors (351)	Percentage of total sample (444)
Job titles		
Full instructor	11(3.13%)	2.48%
Associate instructor	187 (53.28%)	42.12%
Assistant instructor	153 (43.59%)	34.46%
Levels of education		
Master	18 (5.13%)	4.05%
Bachelor	127 (36.18%)	28.60%
Other	206 (58.69%)	46.39%
Years of working experience		
0-5	50 (14.25%)	11.26%
6-10	68 (19.37%)	15.32%
11-15	49 (13.96%)	11.04%
15+	184 (52.42%)	41.44%
Hours of TQM training		
0-10	261 (74.36%)	58.78%
11-20	46 (13.11%)	10.36%
21-30	7 (1.99%)	1.58%
30+	37 (10.54%)	8.33%
Location		
Taipei	50 (14.25%)	11.26%
Kaoshiung	57 (16.24%)	12.84%
Other	244 (69.52%)	54.95%
Type of training program		
Skilled workers	302 (86.04%)	68.01%
Skilled workers & instructors	49 (13.96%)	11.04%
Type of sponsoring agency		
Government	333 (94.87%)	75.00%
Non-government	18 (5.13%)	4.05%
Number of students		
100–	7 (1.99%)	1.58%
101-500	180 (51.28%)	40.54%
501-1000	38 (10.83%)	8.56%
1000+	126 (35.89%)	28.37%

Table 11. Distribution of independent variables for companies' leaders

Independent variables	Number & percentage of total leaders (93)	Percentage of total sample (444)
Job titles		
President	3 (3.22%)	0.68%
Vice-President	5 (5.38%)	1.13%
Manager	30 (32.26%)	6.76%
Other	55 (59.14%)	12.39%
Levels of education		
Doctorate	2 (2.15%)	0.45%
Master	15 (16.13%)	3.38%
Bachelor	48 (51.61%)	10.81%
Other	28 (30.11%)	6.31%
Years of working experience		
0-5	50 (53.76%)	11.26%
6-10	18 (19.35%)	4.05%
11-15	7 (7.53%)	1.58%
15+	18 (19.35%)	4.05%
Hours of TQM training		
0-10	37 (39.78%)	8.33%
11-20	13 (13.98%)	2.93%
21-30	9 (9.68%)	2.03%
30+	34 (36.56%)	7.66%
Location		
Taipei	23 (24.73%)	0.68%
Kaoshiung	6 (6.45%)	1.35%
Other	64 (68.82%)	14.41%
Type of products		
Manufacturing	69(74.19%)	15.54%
Service	11(11.83%)	2.48%
Both	10(10.75%)	2.25%
Other	3 (3.23%)	0.68%
Type of ownership category		
Wholly owned	16 (17.20%)	3.60%
Common stock	77 (82.80%)	17.34%
Number of employees		
100–	22 (23.66%)	4.95%
101-500	30 (32.26%)	6.76%
501-1000	10 (10.75%)	2.25%
1000+	31 (33.33%)	6.98%

The results in Table 10 indicate that the greatest number of VTCs' instructors held the rank of Associate Instructor. There were no doctorate degree holders, and a majority had earned two- or three-year college degrees. Most instructors at VTCs had more than 15 years of working experience at the center. In terms of TQM exposure, most had received less than ten hours of training. Most respondents were based at locations other than the two major cities of Taipei and Kaoshiung. Most of the instructors were involved exclusively in skilled worker preparation; some were involved in preparing teachers and skilled workers. A majority of centers were sponsored by the government. Most respondents indicated that their centers had trained between 101-500 students.

The results in Table 11 indicate that most respondents from companies' leaders held the titles of Chief or Director. The participants included eight individuals holding the rank of President or Vice-President. A majority of the companies' leaders held the Bachelor's degree. Most respondents had between 0-5 years of working experience. The number of hours of TQM training most was commonly 0-10. However, more than a third of the companies' leaders had more than 30 hours of TQM training. Most industrial respondents were based in companies located in cities other than Taipei and Kaoshiung. Most respondents were from manufacturing companies as opposed to service industries. Also, most companies were financed through common stock. In terms of size, one-third of the companies had more than 1000 employees.

A noteworthy fact based on the demographic information from the survey respondents was that VTCs' instructors seemed to have minimal exposure to TQM training. In general, companies' leaders had more exposure to TQM training than did the VTCs' instructors.

Item Analyses

The dependent variables of interest in this study included the core body of knowledge of TQM (scale 1), instructor preferences for TQM learning opportunities (scale 2), and strategies for including TQM in the curriculum (scale 3). Summary statistics by way of arithmetic mean and standard deviation of each item and three sub-scales of instrument are presented in this section. The purpose of item analysis was to measure the perceptions of the respondents for the feasibility of TQM theories and methodologies at VTCs in Taiwan, R.O.C. To identify individual items indicating high and low importance, the items were ordered by the means and standard deviations obtained on the 444 respondents. The reader should note that a mean of 1 corresponded to the lowest end of the degree (negative perception) and 7 to the highest end of the degree (positive perception). The highest 10 and lowest 10 were listed to help VTCs' instructors and companies' leaders identify the three sub-scales (Core body of knowledge of TQM, Instructor preferences for TQM learning opportunities, Strategies for including TQM into curriculum) considered most important or desirable as well as to examine areas which might be difficult to attain. Table 12 provides the itemwise means and standard deviations. Table 13 provides the means and standard deviations of three sub-scales of the instrument.

The items with the ten highest means were items 25 (teamwork and people involvement), 2 (understanding customer expectations and requirements), 5 (measurement of customer satisfaction), 30 (consensus development), 38 (knowledge of oneself), 31 (continuous improvement), 40 (personal commitment and responsibility), 37 (development of new knowledge), 32 (product design for quality), and 4 (proactively seeking feedback from

Table 12. Items means and standard deviations (items listed in descending order of means)

Order	Item #	Brief description of item	Mean	SD
1	Item 25	Teamwork and people involvement	6.1351	1.1500
2	Item 2	Understanding customer expectations and requirements	6.1194	1.1969
3	Item 5	Measurement of customer satisfaction	6.0293	1.1169
4	Item 30	Consensus development	6.0068	1.1353
5	Item 38	Knowledge of oneself	5.9887	1.1050
6	Item 31	Continuous improvement	5.9842	1.1666
7	Item 40	Personal commitment and responsibility	5.9572	1.1542
8	Item 37	Development of new knowledge	5.9347	1.1214
9	Item 32	Product design for quality	5.9279	1.1320
10	Item 4	Proactively seeking feedback from customers	5.9257	1.2982
11	Item 27	Team-building skills	5.8874	1.1738
12	Item 26	Leaders skills	5.8559	1.2397
13	Item 35	Relationship between continuous improvement and global competition	5.8446	1.2282
14	Item 13	Plan-do-check-act cycle	5.8401	1.2331
15	Item 24	Process control concepts	5.8108	1.1755
16	Item 67	The processes for anticipating and responding to future requirements of industry are important for vocational training centers	5.7950	1.1814
17	Item 48	How important you feel it is to teach TQM to trainees at training centers	5.7838	1.1918
18	Item 12	Activity-based cost management concepts	5.7523	1.2577
19	Item 61	The practice of quality principles should encompass everything from continuous improvement of the administrative functions to the process for curriculum development to the teaching methods used in the classroom	5.7320	1.2086
20	Item 47	ISO 9000 standards for quality systems	5.7185	1.2186
21	Item 63	Vocational training centers should treat companies that send their employees to the centers as customers and seek their feedback for improvement	5.6982	1.2512
22	Item 1	Identifying customers	5.6937	1.4429
23	Item 6	Relationship between employee satisfaction and customer satisfaction	5.6847	1.2958
24	Item 66	Having a strong and involved leaders at vocational training centers is the key to successful implementation of TQM curriculum	5.6824	1.2518

Table 12. Continued

25	Item 65	All stakeholders including faculty, staff, and students at the centers must be actively involved in the learning process of TQM from the beginning of the program	5.6802	1.2467
26	Item 29	Employee empowerment	5.6779	1.2525
27	Item 46	Organizational goals and outcomes	5.6509	1.2140
28	Item 60	Vocational trainers should emphasize interdisciplinary faculty teams to teach quality to trainees	5.6374	1.2340
29	Item 28	Team-meeting (facilitation) skills	5.6284	1.2332
30	Item 39	Dealing with organizational change	5.6284	1.2277
31	Item 15	Cost of quality (Prevention cost, Appraisal cost, Failure cost, etc.)	5.6059	1.2977
32	Item 62	Vocational training centers should establish "Quality Improvement Teams" to facilitate continuous improvement of their training programs	5.6036	1.2097
33	Item 34	Importance of design and re-design of processes	5.5946	1.2067
34	Item 42	Systems thinking	5.5923	1.1861
35	Item 22	Measuring processes	5.5878	1.2183
36	Item 41	Understanding learning styles	5.5698	1.2397
37	Item 64	Curriculum revision should involved researching the requirements of students, parents, society, alumni, employers, and faculty	5.5698	1.2667
38	Item 59	The teaching of quality must be integrated within the contents of individual courses as well as across the entire curriculum	5.5383	1.2875
39	Item 21	Difference between building in quality and inspecting in quality	5.5045	1.3244
40	Item 11	Design of experiments	5.4820	1.3972
41	Item 14	Understanding variation	5.4640	1.2752
42	Item 36	Cross-functional interaction	5.4347	1.2508
43	Item 45	Organizational mission statement	5.4324	1.2307
44	Item 20	Flowcharting and process mapping	5.4279	1.3309
45	Item 51	Training center faculty members would spend 1-4 months at a leading TQM company or college/university studying the TQM practice	5.4167	1.3438
46	Item 9	Quality control tools (Pareto diagram, Cause-and-effect diagram, Histogram, etc.)	5.4077	1.3160
47	Item 17	Recognizing data patterns and their implications	5.4009	1.2540
48	Item 49	An industry executive with TQM expertise would work on-site at a training center for a 6-12 month period to provide TQM education to the faculty	5.3784	1.3391

Table 12. Continued

49	Item 58	A TQM resource guide including class outlines and materials, reading, and teaching notes that represent alternative approaches being used in higher education and companies would be produced for vocational training centers' faculty.	5.3716	1.2423
50	Item 56	Training center faculty would attend 2-3 days TQM courses on campus (typically 25 participants per course) that are similar to those that businesses normally provide to their employees. These courses will be provided directly by companies, professional associations, or consultants that normally provide TQM education to business.	5.3626	1.2576
51	Item 8	Selection of statistical process control tools	5.3514	1.3364
52	Item 10	Management and planning tools (Arrow diagram, Tree diagram, Matrix diagram, etc.)	5.3221	1.3429
53	Item 52	A series of (3-5) two-hour television broadcasts aimed at establishing the basic steps that can be taken to incorporate TQM into the training center's curriculum will be presented	5.3176	1.3083
54	Item 7	Definitions of quality according to experts and scholars	5.3131	1.2885
55	Item 16	Root-cause analysis	5.3018	1.3350
56	Item 19	Concepts focusing on process rather than product	5.3018	1.3282
57	Item 57	Workshops would be sponsored by professional TQM societies/organizations that focus on specific issues of TQM such as strategic planning, emerging curricula topics, strategies for developing teamwork, quality indicators, benchmarks, and implementation	5.2703	1.2128
58	Item 23	Difference between common and special causes	5.2680	1.3090
59	Item 50	A senior faculty member from a college or university with real world TQM experience would work at a training center for a 6-12 month period to provide TQM education to the faculty	5.2455	1.3474
60	Item 53	A one-week session would be sponsored by professional TQM societies/organizations and taught by university faculty, industry executives, TQM experts and scholars from around the world. The objectives are to build awareness of TQM concepts and explain the approaches for incorporating TQM into the training center's curriculum	5.2117	1.3030
61	Item 54	A critical mass (35%-75%) of training center faculty members would visit a company for 4-5 days with the purpose of learning about TQM. Following this initial experience, an ongoing relationship (every week for two years) with the company for the continued learning about TQM would be established. This would include sharing of TQM education through the company's classes and the opportunity to observe and participate in the TQM practice at the company	5.1937	1.3365

Table 12. Continued

62	Item 33	Difference between small and large quality improvements	5.1734	1.4235
63	Item 3	Difference between internal and external customers	5.1509	1.4402
64	Item 18	Operational definition (A definition that gives communicable meaning by specifying how the concept is measured and applied within a set of circumstances)	5.1464	1.3584
65	Item 44	Quality Award criteria (Baldrige Award, Deming Prize, etc.)	5.0766	1.3433
66	Item 55	Training center faculty would attend conferences of 200-800 participants sponsored by higher educational institutions, TQM-oriented organizations/societies, or business associations to learn about TQM	4.9369	1.4460
67	Item 43	Theory of constraints	4.8896	1.3865

*Mean: 1 = Not important, Low preference, Strongly disagree
*Mean: 7 = Very important, High preference, Strongly agree

Table 13. Sub-scale means and standard deviations

Name of scale (construct)	Number of items	Mean	Standard deviation
Core body of knowledge of TQM	48 (no. 1-48)	269.2700	40.8000
Instructor preferences for TQM learning opportunities	10 (no. 49-58)	52.7050	9.7611
Strategies for including TQM in the curriculum	9 (no. 59-67)	50.9369	8.8929

Name of scale (construct)	Number of items	Mean (item)	Standard deviation (item)
Core body of knowledge of TQM	48 (no. 1-48)	5.61	0.85
Instructor preferences for TQM learning opportunities	10 (no. 49-58)	5.27	0.98
Strategies for including TQM in the curriculum	9 (no. 59-67)	5.66	0.99

customers); all these items represented elements in the core body of knowledge of TQM (scale 1). Considering that the measurement scale employed an interval from 1-7, the top ten values for the mean reflected a high degree of importance to the core body of knowledge of TQM. The items with the ten lowest means were items 23 (difference between common and special causes), 50 (senior faculty member on loan), 53 (TQM institute), 54 (TQM partnerships), 33 (difference between small and large quality improvements), 3 (difference between internal and external customers), 18 (operational definition), 44 (quality award criteria), 55 (conferences), and 43 (theory of constraints). Most of these items were associated with potential TQM learning opportunities for VTCs' instructors (scale 2). Therefore, the preferences for TQM learning opportunities presented in the data collection instrument were not as high as the perceived importance of the core body of knowledge. Items 59-67 (scale 3) had mean values from 5.54 to 5.80; therefore respondents attached a moderately high degree of importance to their perceptions of the strategies for including TQM into the curriculum.

Based on estimates of central tendency from the item analysis of the instrument, both the VTCs' instructors and companies' leaders held positive perceptions with respect to three scales of the instrument. The total mean of scale 1, which included 48 items, was 5.61; the total mean of scale 2, which included 10 items, was 5.27; the total mean of scale 3, which included 9 items, was 5.66. The results suggested that there was a strong need to teach TQM knowledge and skills at vocational training centers. The perceptions of strategies for including TQM in the curriculum were highly positive; therefore these strategies deserved strong consideration.

It was interesting to note that although the strategies for including TQM in the curriculum and core body of knowledge of TQM were perceived to be highly important by VTCs' instructors and companies' leaders, the TQM learning opportunities as presented in the instrument were rated somewhat lower in importance. This suggested that there might be some alternative TQM learning opportunities that were not considered in the instrument used for data collection. One might also speculate that these alternative learning opportunities might be related specifically to societal and cultural differences that existed between the people in the United States and Taiwan, R.O.C. For example, the Procter and Gamble Company Report (1992) stated that American college/university deans regarded business/education partnerships, TQM resource guide, and on-going faculty development as highly important. In contrast, a number of respondents in this study, all from Taiwan, seemed to attach relatively low importance to those TQM learning opportunities.

Reliability of the Instrument

The internal consistency approach was the logical choice to estimate reliability because of practicality. Other techniques such as the alternative form or test-retest methods required two independent administrations of the instrument to the same group of people or two alternative forms of the measuring instrument. The split-half approach required adjusting factors for test length (Borg & Gall, 1983).

A reliability analysis was conducted for each of the three major scales assumed in formulating the instrument. The total sample size used in these estimates was 444, the number of valid responses. The reliability of the overall instrument was estimated as 0.9773. Scale 1 had the highest reliability (0.9745) and scale 2 had the lowest reliability (0.9094). This value

for the alpha coefficient clearly met the general requirement of an attitudinal measure in terms of reliability (Nunnally, 1978). The reliability of the overall instrument and the three major scales could be considered sufficiently high for continued use in practical application. The reliability coefficients are reported in Table 14.

Table 14. Reliability coefficient for the instrument (N=444)

Name of scale (construct)	Number of items	Reliability coefficient (Cronbach's alpha)
1. Core body of knowledge of TQM	48 (no. 1-48)	.9745
2. Instructor preferences for TQM learning opportunities	10 (no. 49-58)	.9094
3. Strategies for including TQM in the curriculum	9 (no. 59-67)	.9288
Overall	67	.9773

Assumptions for the Statistical Analyses

The following results presented in this chapter utilize statistics that have one or more assumptions required to ensure that the Type I and Type II error control is at the nominal values selected by the researcher. For one-way analysis of variance these include:

(a) Independent sampling. For example, assurance that the respondents to a questionnaire do not discuss their responses before recording.

(b) Normally distributed errors. This may be indirectly observed by plotting the frequency distribution and comparison to the normal curve or application of Chi-square or Kolmogorov-Smirnov statistics for tests that the distribution or cumulative distribution does not deviate significantly from the normal distribution.

(c) Homogeneity of variance. Several tests such as the F-Max test may be used to test for equality of variance.

In addition, the analyses of covariance and multivariate analyses of covariance assume:

(d) Homogeneity of covariance matrices among the groups analyzed. Again, several tests exist for sphericity or homogeneity of covariance.

In reporting the results of this chapter, there are some instances where one of these assumptions may be violated to varying degrees. While a moderate departure from normality has been found to have relatively little impact on error rates in many studies, the degree of violation of homogeneity of variance and covariance is less well understood. Where tests have been performed for these assumptions, the reader is cautioned in examining the results if the assumptions appear to have been violated.

The assumptions of normality for the three sub-scales measured in the instrument were tested. Appendix I shows the shape of the distribution of collected data as applied to the three scales of the instrument.

Tests of Hypotheses (1-8)

To test the hypotheses that the scale 1 (core body of knowledge of TQM), scale 2 (instructor preferences for TQM learning opportunities), and scale 3 (strategies for including TQM in the curriculum) had equal means for groups defined by job titles, levels of education, years of working experience, hours of training of TQM of VTCs' instructors, location, type of training program, type of sponsoring agency, and number of students at the center, one-way analyses of variance (ANOVA) were conducted at the 95% confidence level. Thus, there were eight ANOVAs completed for each of the three scales. These analyses were all

performed on the sample of responses obtained from the VTCs' instructors. Scheffe' post-hoc comparisons among groups were also performed at the 95% confidence level in order to determine which, if any, simple contrasts among groups were significant.

Hypothesis 1

Ho 1: There are no significant differences in scales 1, 2, and 3 among VTCs' instructors as a function of job titles.

HoI.1: The means of scale 1 observed for VTC instructor groups defined by job titles do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Ho 1.2: The means of scale 2 observed for VTC instructor groups defined by job titles do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Ho 1.3: The means of scale 3 observed for VTC instructor groups defined by job titles do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 15 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 16 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by job titles of the subjects sampled.

From Table 15, the mean values for the three scales of instructors holding Full, Associate, and Assistant titles ranged from 5.23 to 5.73. Therefore, it could be concluded

that instructors' perceptions were positive with respect to scales 1, 2, and 3. From Table 16, it could be concluded that the perceptions of VTCs' instructors on the core body of knowledge of TQM ($F=0.849$, $p>0.05$), TQM learning opportunities ($F=0.9$, $p>0.05$), and strategies for including TQM into the curriculum ($F=0.122$, $p>0.05$) did not differ significantly based on job titles. The null hypotheses H_O 1.1, H_O 1.2, and H_O 1.3 were retained.

Hypothesis 2

H_O 2: There are no significant differences in scales 1, 2, and 3 among VTCs' instructors as a function of levels of education.

H_O 2.1: The means of scale 1 observed for VTC instructor groups defined by levels of education do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Table 15. Descriptive statistics for hypothesis 1

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. Full instructor (11)	267.0000	5.56	47.4400	0.99
2. Associate instructor (187)	268.7900	5.60	44.1300	0.92
3. Assistant instructor (153)	262.7500	5.47	40.3600	0.84
Scale 2				
1. Full instructor (11)	55.3636	5.54	10.2399	1.02
2. Associate instructor (187)	52.2674	5.23	10.6913	1.07
3. Assistant instructor (153)	53.3922	5.34	8.9260	0.89
Scale 3				
1. Full instructor (11)	51.5455	5.73	8.1653	0.91
2. Associate instructor (187)	50.5989	5.62	9.4979	1.06
3. Assistant instructor (153)	50.2941	5.59	8.7305	0.97

Table 16. ANOVA for Hypothesis 1

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	3085.585	2	1542.792	.849	.429
1. Full instructor	Groups					
2. Associate instructor	Within	632332	348	1817.046		
3. Assistant instructor	Groups					
	Total	635418	350			
Scale 2	Between	177.943	2	88.971	.900	.408
1. Full instructor	Groups					
2. Associate instructor	Within	34419.6	348	98.907		
3. Assistant instructor	Groups					
	Total	34597.6	350			
Scale 3	Between	20.332	2	10.166	.122	.885
1. Full instructor	Groups					
2. Associate instructor	Within	29031.4	348	83.424		
3. Assistant instructor	Groups					
	Total	29051.7	350			

Ho 2.2: The means of scale 2 observed for VTC instructor groups defined by levels of education do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Ho 2.3: The means of scale 3 observed for VTC instructor groups defined by levels of education do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used with post-hoc comparisons using the Scheffe' procedure for testing the differences between pairs of means. Table 17 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 18 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by levels of education of the subjects sampled. Table 19 below presents the Scheffe' contrasts.

Table 17. Descriptive statistics for hypothesis 2

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
2. Masters (18)	244.0600	5.08	39.0200	0.81
3. Bachelor (127)	258.9800	5.40	45.4600	0.95
4. Others (206)	272.4200	5.68	39.8600	0.83
Scale 2				
2. Masters (18)	51.8889	5.19	8.3094	0.83
3. Bachelor (127)	52.4882	5.25	10.7363	1.07
4. Others (206)	53.1650	5.32	9.5882	0.96
Scale 3				
2. Masters (18)	48.5556	5.40	9.9719	1.11
3. Bachelor (127)	48.9528	5.44	9.9218	1.10
4. Others (206)	51.6165	5.74	8.3604	0.93

Table 18. ANOVA for hypothesis 2

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.	Scheffe'
Scale 1	Between	23413.5	2	11706.800	6.657	.001*	
2. Master	Groups						(4)>(2)
3. Bachelor	Within	612004	348	1758.632			(4)>(3)
4. Others	Groups						
	Total	635418	350				
Scale 2	Between	53.691	2	26.846	.270	.763	
2. Master	Groups						
3. Bachelor	Within	34543.9	348	99.264			
4. Other	Groups						
	Total	34597.6	350				
Scale 3	Between	628.879	2	314.439	3.850	.022*	
2. Master	Groups						(4)>(3)
3. Bachelor	Within	28422.9	348	81.675			
4. Other	Groups						
	Total	29051.7	350				

Table 19. Scheffe' multiple comparisons for hypothesis 2

Variables	Levels of education I	J	Mean difference (I-J)	Std. error	Sig.
Scale 1	2	3	-14.92	10.562	.370
		4	-28.36*	10.307	.024
	3	2	14.92	10.562	.370
		4	-13.44*	4.731	.019
	4	2	28.36*	10.307	.024
		3	13.44*	4.731	.019
Scale 3	2	3	-0.3972	2.276	.985
		4	-3.0609	2.221	.388
	3	2	0.3972	2.276	.985
		4	-2.6637*	1.020	.034
	4	2	3.0609	2.221	.388
		3	2.6637*	1.020	.034

From Table 17, the mean values for the three scales of instructor holding Master's, Bachelor's, and other degrees ranged from 5.08 to 5.74. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. From Tables 18 and 19, it could be concluded that the perceptions of VTCs' instructors on the core body of knowledge of TQM ($F = 6.657$, $p < 0.05$) and strategies for including TQM in the curriculum ($F = 3.85$, $p < 0.05$) were all significantly different based on levels of education. Therefore, the null hypotheses H_O 2.1 and H_O 2.3 were rejected. The Scheffe' post-hoc statistic revealed that the group with college degrees rated more positively than the group with Bachelor's did and the group with Master's degrees did in their perceptions on the core body of knowledge of TQM. The group with college degrees rated more positively than the group with Bachelor's degrees did in their perceptions on the strategies for including TQM in the curriculum. However, the perceptions of instructors on the TQM learning opportunities

($F=0.27$, $p>0.05$) did not differ significantly based on the levels of education. The null hypothesis H_O 2.2 was retained.

Hypothesis 3

H_O 3: There are no significant differences in scales 1, 2, and 3 among VTCs' instructors as a function of years of working experience at the center.

H_O 3.1: The means of scale 1 observed for VTC instructor groups defined by years of working experience do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 3.2: The means of scale 2 observed for VTC instructor groups defined by years of working experience do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 3.3: The means of scale 3 observed for VTC instructor groups defined by years of working experience do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 20 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 21 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by years of working experience of the subjects sampled.

From Table 20, the mean values for the three scales of instructors having 0-5, 6-10, 11-15, and 15+ years of working experience ranged from 5.17 to 5.73. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. From Table 21, it could be concluded that the perceptions of VTCs' instructors on the core body of

Table 20. Descriptive statistics for hypothesis 3

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. 0 - 5 (50)	273.8000	5.70	33.4500	0.70
2. 6 - 10 (68)	267.8200	5.58	41.1500	0.86
3. 11 - 15 (49)	266.7300	5.57	45.0500	0.94
4. 15+ (184)	263.2000	5.48	44.6600	0.93
Scale 2				
1. 0 - 5 (50)	54.6600	5.47	7.7975	0.78
2. 6 - 10 (68)	53.9706	5.40	11.2965	1.13
3. 11 - 15 (49)	53.8980	5.39	10.0607	1.01
4. 15+ (184)	51.6739	5.17	9.8215	0.98
Scale 3				
1. 0 - 5.(50)	51.5600	5.73	8.3816	0.93
2. 6 - 10 (68)	49.9118	5.55	9.7930	1.09
3. 11 - 15 (49)	49.7143	5.52	10.1735	1.13
4. 15+ (184)	50.6304	5.63	8.7787	0.98

Table 21. ANOVA for hypothesis 3

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	4732.517	3	1577.506	.868	.458
1. 0 - 5	Groups					
2. 6 - 10	Within	630685	347	1817.536		
3. 11 - 15	Groups					
4. 15+	Total	635418	350			
Scale 2	Between	557.504	3	185.835	1.894	.130
1. 0 - 5	Groups					
2. 6 - 10	Within	34040.1	347	98.098		
3. 11 - 15	Groups					
4. 15+	Total	34597.6	350			
Scale 3	Between	113.083	3	37.694	.452	.716
1. 0 - 5	Groups					
2. 6 - 10	Within	28938.7	347	83.397		
3. 11 - 15	Groups					
4. 15+	Total	29051.7	350			

knowledge of TQM ($F=0.868$, $p>0.05$), TQM learning opportunities ($F=1.894$, $p>0.05$), and strategies for including TQM in the curriculum ($F=0.452$, $p>0.05$) did not differ significantly based on years of working experience. Therefore, the null hypotheses H_O 3.1, H_O 3.2, and H_O 3.3 were retained.

Hypothesis 4

H_O 4: There are no significant differences in scales 1, 2, and 3 among VTCs' instructors as a function of number of hours of TQM training received.

H_O 4.1: The means of scale 1 observed for VTC instructor groups defined by number of hours of TQM training do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 4.2: The means of scale 2 observed for VTC instructor groups defined by number of hours of TQM training do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 4.3: The means of scale 3 observed for VTC instructor groups defined by number of hours of TQM training do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used with post-hoc comparisons using the Scheffe' procedure for testing the differences between pairs of means. Table 22 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 23 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by number of hours of TQM training of the subjects sampled. Table 24 below presents the Scheffe' contrasts.

Table 22. Descriptive statistics for hypothesis 4

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. 0 - 10 (261)	262.4200	5.47	43.1400	0.90
2. 11 - 20 (46)	274.9300	5.73	35.2900	0.74
3. 21 - 30 (7)	290.1400	6.04	37.7200	0.79
4. 30+ (37)	276.5400	5.76	44.6400	0.93
Scale 2				
1. 0 - 10 (261)	52.5057	5.25	10.0765	1.01
2. 11 - 20 (46)	53.2609	5.33	8.3038	0.83
3. 21 - 30 (7)	51.8571	5.19	10.0071	1.00
4. 30+ (37)	55.0000	5.50	10.9011	1.09
Scale 3				
1. 0 - 10 (261)	49.9080	5.55	9.0634	1.01
2. 11 - 20 (46)	52.5217	5.84	9.3065	1.03
3. 21 - 30 (7)	49.1429	5.46	10.1559	1.13
4. 30+ (37)	52.3784	5.82	8.7475	0.97

From Table 22, the mean values for the three scales of instructors having 0-10, 11-20, 21-30, and 30+ hours of TQM training ranged from 5.19 to 6.04. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. From Tables 23 and 24, it could be concluded that the perceptions of VTCs' instructors on the core body of knowledge of TQM ($F=2.836$, $p<0.05$) were significantly different based on the number of hours of TQM training received. Therefore, the null hypothesis H_O 4.1 was rejected. However, the perceptions of TQM learning opportunities ($F=0.729$, $p>0.05$) and strategies for including TQM in the curriculum ($F=1.709$, $p>0.05$) did not differ significantly based on the hours of TQM training received. The null hypotheses H_O 4.2 and H_O 4.3 were retained.

Table 23. ANOVA for hypothesis 4

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	15209.2	3	5069.727	2.836	.038*
1. 0 - 10	Groups					
2. 11 - 20	Within	620208	347	1787.344		
3. 21 - 30	Groups					
4. 30+	Total	635418	350			
Scale 2	Between	216.622	3	72.207	.729	.535
1. 0 - 10	Groups					
2. 11 - 20	Within	34381.0	347	99.081		
3. 21 - 30	Groups					
4. 30+	Total	34597.6	350			
Scale 3	Between	422.912	3	140.971	1.709	.165
1. 0 - 10	Groups					
2. 11 - 20	Within	28628.8	347	82.504		
3. 21 - 30	Groups					
4. 30+	Total	29051.7	350			

Table 24. Scheffe' multiple comparisons for hypothesis 4

Variables	Hours of TQM I	J	Mean difference (I-J)	Std. error	Sig.
Scale 1	1	2	-12.52	6.760	.332
		3	-27.73	16.192	.404
		4	-14.12	7.427	.308
	2	1	12.52	6.760	.332
		3	-15.21	17.152	.853
		4	-1.61	9.336	.999
	3	1	27.73	16.192	.404
		2	15.21	17.152	.853
		4	13.60	17.425	.894
	4	1	14.12	7.427	.308
		2	1.61	9.336	.999
		3	-13.60	17.425	.894

Hypothesis 5

H_O 5: There are no significant differences in scales 1, 2, and 3 among VTCs' instructors as a function of location of vocational training center.

H_O 5.1: The means of scale 1 observed for VTC instructor groups defined by location of vocational training center do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 5.2: The means of scale 2 observed for VTC instructor groups defined by location of vocational training center do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 5.3: The means of scale 3 observed for VTC instructor groups defined by location of vocational training center do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used with post-hoc comparisons using the Scheffe' procedure for testing the differences between pairs of means. Table 25 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 26 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by location of vocational training center of the subjects sampled. Table 27 below presents the Scheffe' contrasts.

From Table 25, the mean values for the three scales of instructors at Taipei, Kaoshiung and other cities ranged from 5.06 to 6.19. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. From Tables 26 and 27, it could be concluded that the perceptions of VTCs' instructors on the core body of

Table 25. Descriptive statistics for hypothesis 5

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. Taipei (50)	293.8800	6.12	28.1000	0.59
2. Kaoshiung (57)	258.3700	5.38	34.1400	0.71
3. Other (244)	262.2100	5.46	44.7100	0.93
Scale 2				
1. Taipei (50)	56.9400	5.70	9.7821	0.98
2. Kaoshiung (57)	50.5789	5.06	8.1743	0.82
3. Other (244)	52.5492	5.25	10.1459	1.01
Scale 3				
1. Taipei (50)	55.7000	6.19	7.4430	0.83
2. Kaoshiung (57)	46.9123	5.21	8.0029	0.89
3. Other (244)	50.2664	5.59	9.2188	1.02

Table 26. ANOVA for hypothesis 5

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.	Scheffe'
Scale 1	Between	45680.0	2	2840.000	13.478	.000*	
1. Taipei	Groups						(1)>(2)
2. Kaoshiung	Within	589737	348	1694.648			(1)>(3)
3. Other	Groups						
	Total	635418	350				
Scale 2	Between	1152.465	2	576.233	5.996	.003*	
1. Taipei	Groups						(1)>(2)
2. Kaoshiung	Within	33445.1	348	96.107			(1)>(3)
3. Other	Groups						
	Total	34597.6	350				
Scale 3	Between	2098.998	2	1049.499	13.551	.000*	
1. Taipei	Groups						(1)>(2)
2. Kaoshiung	Within	26952.7	348	77.450			(1)>(3}
3. Other	Groups						(3)>(2)
	Total	29051.7	350				

Table 27. Scheffe' multiple comparisons for hypothesis 5

Variables	Location I	Location J	Mean difference (I-J)	Std. error	Sig.
Scale 1	1	2	35.51*	7.976	.000
		3	31.67*	6.390	.000
	2	1	-35.51*	7.976	.000
		3	-3.84	6.056	.818
	3	1	-31.67*	6.390	.000
		2	3.84	6.056	.818
Scale 2	1	2	6.3611*	1.900	.004
		3	4.3908*	1.522	.016
	2	1	-6.3611*	1.900	.004
		3	-1.9702	1.442	.394
	3	1	-4.3908*	1.522	.016
		2	1.9702	1.442	.394
Scale 3	1	2	8.7877*	1.705	.000
		3	5.4336*	1.366	.000
	2	1	-8.7877*	1.705	.000
		3	-3.3541*	1.295	.036
	3	1	-5.4336*	1.366	.000
		2	3.3541*	1.295	.036

knowledge of TQM ($F = 13.478$, $p < 0.05$), TQM learning opportunities ($F = 5.996$, $p < 0.05$), and strategies for including TQM in the curriculum ($F = 13.551$, $p < 0.05$) were all significantly different based on location of vocational training center. Therefore, the null hypotheses H_O 5.1, H_O 5.2, and H_O 5.3 were rejected. The Scheffe' post-hoc statistic revealed that instructors at Taipei rated more positively than their colleagues at Kaoshiung did and at other cities did in their perceptions on all the three scales considered. Instructors at other cities rated more positively than their colleagues at Kaoshiung did in their perceptions on the strategies for including TQM in the curriculum.

Hypothesis 6

H_O 6: There are no significant differences in scales 1, 2, and 3 among VTCs' instructors as a function of type of training program.

H_O 6.1: The means of scale 1 observed for VTC instructor groups defined by type of training program do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 6.2: The means of scale 2 observed for VTC instructor groups defined by type of training program do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 6.3: The means of scale 3 observed for VTC instructor groups defined by type of training program do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 28 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 29 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by type of training program of the subjects sampled.

From Table 28, the mean values for the three scales of instructors in skilled worker, skilled worker and teacher training programs ranged from 5.27 to 5.71. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. From Table 29, it could be concluded that the perceptions of VTCs' instructors on the core body of knowledge of TQM ($F=0.013$, $p>0.05$), TQM learning opportunities ($F=0.651$, $p>0.05$), and strategies for including TQM in the curriculum ($F=0.521$, $p>0.05$) did not differ significantly

Table 28. Descriptive statistics for hypothesis 6

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. Skilled worker program (302)	265.9900	5.54	44.0400	0.92
3. Skilled worker and teacher program (49)	266.7600	5.56	32.8200	0.68
Scale 2				
1. Skilled worker program (302)	52.6821	5.27	9.8398	0.98
3. Skilled worker and teacher program (49)	53.9184	5.39	10.5965	1.06
Scale 3				
1. Skilled worker program (302)	50.3543	5.59	9.3431	1.04
3. Skilled worker and teacher program (49)	51.3673	5.71	7.5462	0.84

Table 29. ANOVA for hypothesis 6

Variables	Variance Source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	24.462	1	24.462	.013	.908
1. Skilled worker program	Groups					
3. Skilled worker and	Within	635393	349	1820.610		
teacher program	Groups					
	Total	635418	350			
Scale 2	Between	64.433	1	64.433	.651	.420
1. Skilled worker program	Groups					
3. Skilled worker and	Within	34533.2	349	98.949		
teacher program	Groups					
	Total	34597.6	350			
Scale 3	Between	43.266	1	43.266	.521	.471
1. Skilled worker program	Groups					
3. Skilled worker and	Within	29008.5	349	83.119		
teacher program	Groups					
	Total	29051.7	350			

based on the type of training program. Therefore, the null hypotheses H_O 6.1, H_O 6.2, and H_O 6.3 were retained.

Hypothesis 7

H_O 7: There are no significant differences in scales 1, 2, and 3 among VTCs' instructors as a function of type of sponsoring agency.

H_O 7.1: The means of scale 1 observed for VTC instructor groups defined by type of sponsoring agency do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 7.2: The means of scale 2 observed for VTC instructor groups defined by type of sponsoring agency do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 7.3: The means of scale 3 observed for VTC instructor groups defined by type of sponsoring agency do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 30 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 31 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by type of sponsoring agency of the subjects sampled.

From Table 30, the mean values for the three scales of instructors in government, non-government agency ranged from 5.27 to 6.05. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. From Table 31, it could be concluded that the perceptions of VTCs' instructors on the core body of knowledge

Table 30. Descriptive statistics for hypothesis 7

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. Government (333)	264.8000	5.52	42.8100	0.89
2. Non-government (18)	290.1700	6.05	30.7700	0.64
Scale 2				
1. Government (333)	52.6607	5.27	10.0808	1.01
2. Non-government (18)	56.4444	5.64	6.0120	0.60
Scale 3				
1. Government (333)	50.3033	5.59	9.1859	1.02
2. Non-government (18)	54.0556	6.01	6.8468	0.76

Table 31. ANOVA for hypothesis 7

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.	
Scale 1	Between	10989.5	1	10989.500	6.142	.014*	(2)>(1)
1. Government	Groups						
2. Non-government	Within Groups	624428	349	1789.192			
	Total	635418	350				
Scale 2	Between	244.491	1	244.491	2.484	.116	
1. Government	Groups						
2. Non-government	Within Groups	34353.1	349	98.433			
	Total	34597.6	350				
Scale 3	Between	240.433	1	240.433	2.912	.089	
1. Government	Groups						
2. Non-government	Within Groups	28811.3	349	82.554			
	Total	29051.7	350				

of TQM ($F=6.142$, $p<0.05$) were significantly different based on the type of sponsoring agency. Therefore, the null hypothesis H_O 7.1 was rejected. The mean values revealed that non-government sponsored instructors rated more positively than government sponsored instructors did in their perceptions on the core body of knowledge of TQM. However, the

perceptions of instructors on TQM learning opportunities ($F=2.484$, $p>0.05$) and strategies for including TQM into the curriculum ($F=2.912$, $p>0.05$) did not differ significantly based on the type of sponsoring agency. The null hypotheses H_O 7.2 and H_O 7.3 were retained.

Hypothesis 8

H_O 8: There are no significant differences in scales 1, 2, and 3 among VTCs' instructors as a function of number of students at vocational training center.

H_O 8.1: The means of scale 1 observed for VTC instructor groups defined by number of students at vocational training center do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 8.2: The means of scale 2 observed for VTC instructor groups defined by number of students at vocational training center do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 8.3: The means of scale 3 observed for VTC instructor groups defined by number of students at vocational training center do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 32 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 33 below presents the results of the analysis of variance on scales

Table 32. Descriptive statistics for hypothesis 8

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. 100– (7)	248.4300	5.18	43.0800	0.90
2. 101-500 (180)	267.9200	5.58	40.3100	0.84
3. 501-1000 (38)	269.5800	5.62	37.0200	0.77
4. 1000+ (126)	263.4400	5.49	47.2100	0.98
Scale 2				
1. 100– (7)	52.8571	5.29	10.7615	1.08
2. 101-500 (180)	53.1444	5.31	9.7494	0.97
3. 501-1000 (38)	51.4737	5.15	9.8878	0.99
4. 1000+ (126)	52.8571	5.29	10.2697	1.03
Scale 3				
1. 100– (7)	50.7143	5.63	5.4685	0.61
2. 101-500 (180)	50.3611	5.60	8.6746	0.96
3. 501-1000 (38)	51.5263	5.73	8.9193	0.99
4. 1000+ (126)	50.3651	5.60	9.9652	1.11

Table 33. ANOVA for hypothesis 8

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	4133.790	3	1377.930	.757	.519
1. 100–	Groups					
2. 101-500	Within	631284	347	1819.261		
3. 501-1000	Groups					
4. 1000+	Total	635418	350			
Scale 2	Between	87.586	3	29.195	.294	.830
1. 100–	Groups					
2. 101-500	Within	34510.0	347	99.452		
3. 501-1000	Groups					
4. 1000+	Total	34597.6	350			
Scale 3	Between	46.107	3	15.369	.184	.907
1. 100–	Groups					
2. 101-500	Within	29005.6	347	83.590		
3. 501-1000	Groups					
4. 1000+	Total	29051.7	350			

1, 2, and 3 for groups defined by number of students at vocational training center of the subjects sampled.

From Table 32, the mean values for the three scales of instructors from different size centers ranged from 5.15 to 5.73. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. From Table 33, it could be concluded that the perceptions of instructors on the core body of knowledge of TQM ($F=0.757$, $p>0.05$), TQM learning opportunities ($F=0.294$, $p>0.05$), and strategies for including TQM into the curriculum ($F=0.184$, $p>0.05$) did not differ significantly based on number of students of vocational training center. Therefore, the null hypotheses H_O 8.1, H_O 8.2, and H_O 8.3 were retained.

Tests of Hypotheses (9-16)

To test the hypotheses that the scale 1 (core body of knowledge of TQM); scale 2 (instructor preferences for TQM learning opportunities; and scale 3 (strategies for including TQM in the curriculum) had equal means for groups defined by job titles, levels of education, years of working experience, hours of training of TQM of companies' leaders, location, type of products, type of ownership category, and number of employees at the companies, one-way analyses of variance (ANOVA) were conducted at the 95% confidence level. Thus, there were eight ANOVAs completed for each of the three scales. These analyses were all performed on the sample of responses obtained from the companies' leaders. Scheffe' post-hoc comparisons among groups were also performed at the 95% confidence level in order to determine which, if any, simple contrasts among groups were significant.

Hypothesis 9

H_O 9: There are no significant differences in scales 1, 2, and 3 among companies' leaders as a function of job titles.

H_O 9.1: The means of scale 1 observed for companies' leaders groups defined by job titles do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 9.2: The means of scale 2 observed for companies' leaders groups defined by job titles do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 9.3: The means of scale 3 observed for companies' leaders groups defined by job titles do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 34 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 35 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by job titles of the subjects sampled.

From Table 34, the mean values for the three scales of leaders holding President, Vice-President, Manager and other titles ranged from 5.07 to 5.97. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. From Table 35, it could be concluded that the perceptions of companies' leaders on the core body of knowledge of TQM ($F=1.218$, $p>0.05$), TQM learning opportunities ($F=0.030$,

Table 34. Descriptive statistics or hypothesis 9

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. President (3)	267.6700	5.58	54.8500	1.14
2. Vice President (5)	262.6000	5.47	26.3000	0.55
3. Manager (30)	278.4700	5.80	29.3200	0.61
4. Others (55)	285.1500	5.94	29.8500	0.62
Scale 2				
1. President (3)	50.6667	5.07	3.2146	0.32
2. Vice President (5)	52.2000	5.22	8.0747	0.81
3. Manager (30)	52.3333	5.23	7.7028	0.77
4. Others (55)	52.1091	5.21	10.1501	1.02
Scale 3				
1. President (3)	52.3333	5.81	7.7675	0.86
2. Vice president (5)	46.2000	5.13	6.2209	0.69
3. Manager (30)	51.7000	5.74	7.7600	0.86
4. Others (55)	53.6909	5.97	7.8643	0.87

Table 35. ANOVA for hypothesis 9

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	3359.529	3	1119.843	1.218	.308
1. President	Groups					
2. Vice President	Within	81852.2	89	919.687		
3. Manager	Groups					
4. Other	Total	85211.7	92			
Scale 2	Between	7.704	3	2.568	.030	.993
1. President	Groups					
2. Vice President	Within	7565.479	89	85.005		
3. Manager	Groups					
4. Other	Total	7573.183	92			
Scale 3	Between	294.767	3	98.256	1.631	.188
1. President	Groups					
2. Vice president	Within	5361.512	89	60.242		
3. Manager	Groups					
4. Other	Total	5656.280	92			

p>0.05), and strategies for including TQM in the curriculum (F=1.631, p>0.05) did not differ significantly based on job titles. Therefore, the null hypotheses H_O 9.1, H_O 9.2, and H_O 9.3 were retained.

Hypothesis 10

H_O 10: There are no significant differences in scales 1, 2, and 3 among companies' leaders as a function of levels of education.

H_O 10.1: The means of scale 1 observed for companies' leaders groups defined by levels of education do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 10.2: The means of scale 2 observed for companies' leaders groups defined by levels of education do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 10.3: The means of scale 3 observed for companies' leaders groups defined by levels of education do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used with post-hoc comparisons using the Scheffe' procedure for testing the differences between pairs of means. Table 36 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 37 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by levels of education of the subjects sampled. Table 38 below presents the Scheffe' contrasts.

From Table 36, the mean values for the three scales of leaders holding Doctorate, Master's, Bachelor's, and other degrees ranged from 5.00 to 6.20. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. From Tables 37 and 38, it could be concluded that the perceptions of companies' leaders on TQM learning opportunities ($F = 2.985$, $p < 0.05$) were significantly different based on levels of education. Therefore, the null hypothesis H_O 10.2 was rejected. The Scheffe' post-hoc statistic revealed that the group with college degrees rated more positively than the group with Bachelor's did in their perceptions on TQM learning opportunities. However, the perceptions of companies' leaders on the core body of knowledge of TQM ($F=0.572$, $p>0.05$) and strategies for including TQM in the curriculum ($F=2.629$, $p>0.05$) did not differ significantly based on the levels of education. The null hypotheses H_O 10.1 and H_O 10.2 were retained.

Table 36. Descriptive statistics for hypothesis 10

Variables (N)	Mean	Mean (item)	Std. deviation	Std. Deviation (item)
Scale 1				
1. Doctorate (2)	279.5000	5.82	7.7800	0.16
2. Master (15)	282.4000	5.88	31.2000	0.65
3. Bachelor (48)	277.5400	5.78	27.7300	0.58
4. Other (28)	287.0000	5.98	35.3600	0.74
Scale 2				
1. Doctorate (2)	57.0000	5.70	2.8284	0.28
2. Master (15)	51.2667	5.13	8.4301	0.84
3. Bachelor (48)	49.9792	4.99	9.0847	0.91
4. Other (28)	55.9643	5.60	8.6044	0.86
Scale 3				
1. Doctorate (2)	49.0000	5.44	2.8284	0.31
2. Master (15)	52.8000	5.87	6.6462	0.74
3. Bachelor (48)	50.8333	5.65	8.3113	0.92
4. Other (28)	55.7857	6.20	6.9992	0.78

Table 37. ANOVA for hypothesis 10

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.	Scheffe'
Scale 1	Between	1611.682	3	537.227	.572	.635	
1. Doctorate	Groups						
2. Master	Within	83600.0	89	939.326			
3. Bachelor	Groups						
4. Other	Total	85211.7	92				
Scale 2	Between	692.306	3	230.769	2.985	.035*	
1. Doctorate	Groups						(4)>(3)
2. Master	Within	6880.877	89	77.313			
3. Bachelor	Groups						
4. Other	Total	7573.183	92				
Scale 3	Between	460.499	3	153.500	2.629	.055	
1. Doctorate	Groups						
2. Master	Within	5195.781	89	58.380			
3. Bachelor	Groups						
4. Other	Total	5656.280	92				

Table 38. Scheffe' multiple comparisons for hypothesis 10

Variables	Levels of education I	J	Mean difference (I-J)	Std. error	Sig.
Scale 2	1	2	5.7333	6.619	.861
		3	7.0208	6.349	.748
		4	1.0357	6.436	.999
	2	1	-5.7333	6.619	.861
		3	1.2875	2.601	.970
		4	-4.6976	2.813	.430
	3	1	-7.0208	6.346	.748
		2	-1.2875	2.601	.970
		4	-5.9851*	2.091	.049
	4	1	-1.0357	6.436	.999
		2	4.6976	2.813	.430
		3	5.9851*	2.091	.049

Hypothesis 11

H_O 11: There are no significant differences in scales 1, 2, and 3 among companies' leaders as a function of years of working experience at the company.

H_O 11.1: The means of scale 1 observed for companies' leaders groups defined by years of working experience at the company do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 11.2: The means of scale 2 observed for companies' leaders groups defined by years of working experience at the company do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 11.3: The means of scale 3 observed for companies' leaders groups defined by years of working experience at the company do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 39 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 40 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by years of working experience at the company of the subjects sampled.

From Table 39, the mean values for the three scales of leaders having 0-5, 6-10, 11-15, 15+ years of working experience ranged from 5.00 to 6.20. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. From Table 40, it could be concluded that the perceptions of companies' leaders on the core body of knowledge of TQM ($F=2.486$, $p>0.05$), TQM learning opportunities ($F=1.431$,

Table 39. Descriptive statistics for hypothesis 11

Variables (N)	Mean	Mean (item)	Std. deviation	Std. Deviation (item)
Scale 1				
1. 0 - 5 (50)	282.6600	5.89	31.7500	0.66
2. 6 - 10 (18)	286.0000	5.96	29.7500	0.62
3. 11 - 15 (7)	297.7100	6.20	22.0400	0.46
4. 15+ (18)	266.0000	5.54	25.7400	0.54
Scale 2				
1. 0 - 5 (50)	51.8200	5.18	9.7848	0.98
2. 6 - 10 (18)	50.0000	5.00	9.2800	0.93
3. 11 - 15 (7)	58.1429	5.81	8.3352	0.83
4. 15+ (18)	52.8333	5.28	6.1953	0.62
Scale 3				
1. 0 - 5 (50)	53.8800	5.99	7.5933	0.84
2. 6 - 10 (18)	51.8889	5.77	9.0547	1.01
3. 11 - 15 (7)	55.1429	6.13	6.6690	0.74
4. 15+ (18)	48.7778	5.42	6.7349	0.75

Table 40. ANOVA for hypothesis 11

Variables	Variance Source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	6589.050	3	2196.350	2.486	.066
1. 0 - 5	Groups					
2. 6 - 10	Within	78622.6	89	883.401		
3. 11 - 15	Groups					
4. 15+	Total	85211.7	92			
Scale 2	Between	348.446	3	116.149	1.431	.239
1. 0 - 5	Groups					
2. 6 - 10	Within	7224.737	89	81.177		
3. 11 - 15	Groups					
4. 15+	Total	7573.183	92			
Scale 3	Between	399.254	3	133.085	2.253	.088
1. 0 - 5	Groups					
2. 6 - 10	Within	5257.026	89	59.068		
3. 11 - 15	Groups					
4. 15+	Total	5656.280	92			

p>0.05), and strategies for including TQM in the curriculum (F=2.253, p>0.05) did not differ significantly based on number of years of working experience at the companies. Therefore, the null hypotheses H_O 11.1, H_O 11.2, and H_O 11.3 were retained.

Hypothesis 12

H_O 12: There are no significant differences in scales 1, 2, and 3 among companies' leaders as a function of number of hours of TQM training received.

H_O 12.1: The means of scale 1 observed for companies' leaders groups defined by hours of TQM training received do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 12.2: The means of scale 2 observed for companies' leaders groups defined by hours of TQM training received do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 12.3: The means of scale 3 observed for companies' leaders groups defined by hours of TQM training received do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 41 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 42 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by hours of TQM training received of the subjects sampled.

From Table 41, the mean values for the three scales of leaders having 0-10, 11-20, 21-30, 30+ hours of TQM training ranged from 4.59 to 6.12. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. From

Table 41. Descriptive statistics for hypothesis 12

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. 0 - 10 (37)	287.1900	5.98	33.5900	0.70
2. 11 - 20 (13)	276.3100	5.76	19.1700	0.40
3. 21 - 30 (9)	281.6700	5.87	22.5200	0.47
4. 30+ (34)	276.4700	5.76	31.9700	0.67
Scale 2				
1. 0 - 10 (37)	53.5946	5.36	8.5325	0.85
2. 11 - 20 (13)	53.6154	5.36	7.2289	0.72
3. 21 - 30 (9)	45.8889	4.59	15.0619	0.51
4. 30+ (34)	51.6471	5.16	7.8697	0.79
Scale 3				
1. 0 - 10 (37)	55.0811	6.12	7.9140	0.88
2. 11 - 20 (13)	51.9231	5.77	7.4996	0.83
3. 21 - 30 (9)	48.4444	5.38	9.6580	1.07
4. 30+ (34)	51.2647	5.70	6.8105	0.76

Table 42. ANOVA for hypothesis 12

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	2400.783	3	800.261	.860	.465
1. 0 - 10	Groups					
2. 11 - 20	Within	82810.9	89	930.460		
3. 21 - 30	Groups					
4. 30+	Total	85211.7	92			
Scale 2	Between	466.533	3	155.511	1.948	.128
1. 0 - 10	Groups					
2. 11 - 20	Within	7106.649	89	79.850		
3. 21 - 30	Groups					
4. 30+	Total	7573.183	92			
Scale 3	Between	449.760	3	149.920	2.563	.060
1. 0 - 10	Groups					
2. 11 - 20	Within	5206.520	89	58.500		
3. 21 - 30	Groups					
4. 30+	Total	5656.280	92			

Table 42, it could be concluded that the perceptions of companies' leaders on the core body of knowledge of TQM ($F=0.860$, $p>0.05$), TQM learning opportunities ($F=1.948$, $p>0.05$), and strategies for including TQM in the curriculum ($F=2.563$, $p>0.05$) did not differ significantly based on number of hours of TQM training received. Therefore, the null hypotheses H_O 12.1, H_O 12.2, and H_O 12.3 were retained.

Hypothesis 13

H_O 13: There are no significant differences in scales 1, 2, and 3 among companies' leaders as a function of location of company.

H_O 13.1: The means of scale 1 observed for companies' leaders groups defined by location of company do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 13.2: The means of scale 2 observed for companies' leaders groups defined by location of company do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 13.3: The means of scale 3 observed for companies' leaders groups defined by location of company do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 43 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 44 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by location of company of the subjects sampled.

From Table 43, the mean values for the three scales of leaders at Taipei, Kaoshiung

Table 43. Descriptive statistics for hypothesis 13

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. Taipei (23)	283.1300	5.90	27.7900	0.58
2. Kaoshiung (6)	268.1700	5.59	37.3700	0.78
3. Other (64)	281.7500	5.87	30.8900	0.64
Scale 2				
1. Taipei (23)	53.2174	5.32	8.4259	0.84
2. Kaoshiung (6)	51.3333	5.13	10.0731	1.01
3. Other (64)	51.8281	5.18	9.3156	0.93
Scale 3				
1. Taipei (23)	53.3043	5.92	8.1878	0.91
2. Kaoshiung (6)	45.3333	5.04	9.0701	1.01
3. Other (64)	53.0313	5.89	7.3786	0.82

Table 44. ANOVA for hypothesis 13

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	1124.257	2	562.128	.602	.550
1. Taipei	Groups					
2. Kaoshiung	Within	84087.4	90	934.305		
3. Other	Groups					
	Total	85211.7	92			
Scale 2	Between	36.827	2	18.414	.220	.803
1. Taipei	Groups					
2. Kaoshiung	Within	7536.356	90	83.737		
3. Other	Groups					
	Total	7573.183	92			
Scale 3	Between	340.139	2	170.070	2.879	.061
1. Taipei	Groups					
2. Kaoshiung	Within	5316.140	90	59.068		
3. Other	Groups					
	Total	5656.280	92			

and other cities ranged from 5.04 to 5.92. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. From Table 44, it could be concluded that the perceptions of companies' leaders on the core body of knowledge of TQM ($F=0.602$, $p>0.05$), TQM learning opportunities ($F=0.220$, $p>0.05$), and strategies for including TQM in the curriculum ($F=2.879$, $p>0.05$) did not differ significantly based on location of the company. Therefore, the null hypotheses H_O 13.1, H_O 13.2, and H_O 13.3 were retained.

Hypothesis 14

H_O 14: There are no significant differences in scales 1, 2, and 3 among companies' leaders as a function of type of product.

H_O 14.1: The means of scale 1 observed for companies' leaders groups defined by type of product do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 14.2: The means of scale 2 observed for companies' leaders groups defined by type of product do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 14.3: The means of scale 3 observed for companies' leaders groups defined by type of product do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used with post-hoc comparisons using the Scheffe' procedure for testing the differences between pairs of means. Table 45 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3.

Table 45. Descriptive statistics for hypothesis 14

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. Manufacturing (69)	279.5500	5.82	32.2100	0.67
2. Service (11)	284.8200	5.93	25.8300	0.54
3. Both (10)	278.0000	5.79	20.1500	0.42
4. Other (3)	317.0000	6.60	6.0800	0.13
Scale 2				
1. Manufacturing (69)	51.5797	5.16	9.3233	0.93
2. Service (11)	50.0909	5.01	7.7001	0.77
3. Both (10)	54.3000	5.43	6.8969	0.69
4. Other (3)	65.3333	6.53	1.5275	0.15
Scale 3				
1. Manufacturing (69)	52.3623	5.82	7.7573	0.86
2. Service (11)	53.7273	5.97	8.6266	0.96
3. Both (!0)	50.1000	5.57	7.0938	0.79
4. Other (3)	62.3333	6.93	1.1547	0.13

Table 46 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by type of product of the subjects sampled. Table 47 below presents the Scheffe' contrasts.

From Table 45, the mean values for the three scales of leaders from manufacturing, service, both and other type of companies ranged from 5.01 to 6.93. Therefore, it could be concluded that leaders' perceptions were positive with respect to scale 1, 2, and 3. From Tables 46 and 47, it could be concluded that the perceptions of companies' leaders on TQM learning opportunities ($F=2.723$, $p<0.05$) were significantly different based on type of products. Therefore, the null hypothesis H_O 14.2 was rejected. However, the perceptions of companies' leaders on the core body of knowledge of TQM ($F=1.569$, $p>0.05$) and the strategies for including TQM in the curriculum ($F=2.044$, $p>0.05$) did not differ significantly

Table 46. ANOVA for hypothesis 14

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	4278.990	3	1426.330	1.569	.203
1. Manufacturing	Groups					
2. Service	Within	80932.7	89	909.356		
3. Both	Groups					
4. Other	Total	85211.7	92			
Scale 2	Between	636.695	3	212.232	2.723	.049*
1. Manufacturing	Groups					
2. Service	Within	6936.487	89	77.938		
3. Both	Groups					
4. Other	Total	7573.183	92			
Scale 3	Between	364.589	3	121.530	2.044	.113
1. Manufacturing	Groups					
2. Service	Within	5291.691	89	59.457		
3. Both	Groups					
4. Other	Total	5656.280	92			

Table 47. Scheffe' multiple comparisons for hypothesis 14

Variables	I	Type of product J	Mean difference (I-J)	Std. error	Sig.
Scale 2	1	2	1.4888	2.866	.965
		3	-2.7203	2.987	.842
		4	-13.7536	5.207	.080
	2	1	-1.4888	2.866	.965
		3	-4.2091	3.857	.756
		4	-15.2424	5.750	.079
	3	1	2.7203	2.987	.842
		2	4.2091	3.857	.756
		4	-11.0333	5.811	.314
	4	1	13.7536	5.207	.080
		2	15.2424	5.750	.079
		3	11.0333	5.811	.314

based on type of products. The null hypotheses H_O 14.1 and H_O 14.3 were retained.

Hypothesis 15

H_O 15: There are no significant differences in scales 1, 2, and 3 among companies' leaders as a function of type of ownership category.

H_O 15.1: The means of scale 1 observed for companies' leaders groups defined by type of ownership category do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 15.2: The means of scale 2 observed for companies' leaders groups defined by type of ownership category do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 15.3: The means of scale 3 observed for companies' leaders groups defined by type of ownership category do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 48 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 49 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by type of ownership category of the subjects sampled.

From Table 48, the mean values for the three scales of leaders for wholly owned, common stock companies ranged from 5.19 to 5.90. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. From Table 49, it could be concluded that the perceptions of companies' leaders on the core body of

Table 48. Descriptive statistics for hypothesis 15

Variables	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. Wholly owned (16)	279.4400	5.82	26.8200	0.56
2. Common stock (77)	281.5800	5.87	31.2800	0.65
Scale 2				
1. Wholly owned (16)	53.2500	5.33	7.6638	0.77
2. Common stock (77)	51.9091	5.19	9.3671	0.94
Scale 3				
1. Wholly owned (16)	50.0625	5.56	7.8014	0.87
2. Common stock (77)	53.1299	5.90	7.7957	0.87

Table 49. ANOVA for hypothesis 15

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	61.060	1	61.060	.065	.799
1. Wholly owned	Groups					
2. Common stock	Within	85150.6	91	935.721		
	Groups					
	Total	85211.7	92			
Scale 2	Between	23.819	1	23.819	.287	.593
1. Wholly owned	Groups					
2. Common stock	Within	7549.364	91	82.960		
	Groups					
	Total	7573.183	92			
Scale 3	Between	124.641	1	124.641	2.050	.156
1. Wholly owned	Groups					
2. Common stock	Within	5531.639	91	60.787		
	Groups					
	Total	5656.280	92			

knowledge of TQM, ($F=0.065$, $p>0.05$), TQM learning opportunities ($F=0.287$, $p>0.05$), and strategies for including TQM in the curriculum ($F=2.050$, $p>0.05$) did not differ significantly based on ownership category. Therefore, the null hypotheses H_o 15.1, H_o 15.2, and H_o 15.3 were retained.

Hypothesis 16

H_O 16: There are no significant differences in scales 1, 2, and 3 among companies' leaders as a function of number of employees at the company.

H_O 16.1: The means of scale 1 observed for companies' leaders groups defined by number of employees at the company do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 16.2: The means of scale 2 observed for companies' leaders groups defined by number of employees at the company do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

H_O 16.3: The means of scale 3 observed for companies' leaders groups defined by number of employees at the company do not differ among themselves in the population sampled greater than expected due to random sampling error as tested at the 95% confidence level.

Fixed effects analysis of variance was used for testing the differences between pairs of means. Table 50 below presents the observed means and standard deviations for the groups on scales 1, 2, and 3. Table 51 below presents the results of the analysis of variance on scales 1, 2, and 3 for groups defined by number of employees at the company of the subjects sampled.

From Table 50, the mean values for the three scales of leaders from different size companies ranged from 4.99 to 6.04. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. From Table 51, it could be concluded that the perceptions of companies' leaders on the core body of knowledge of TQM ($F=0.409$, $p>0.05$), TQM learning opportunities ($F=0.284$, $p>0.05$), and strategies for

Table 50. Descriptive statistics for hypothesis 16

Variables (N)	Mean	Mean (item)	Std. deviation	Std. deviation (item)
Scale 1				
1. 100– (22)	282.9100	5.89	33.7100	0.70
2. 101 - 500 (30)	279.0300	5.81	33.7200	0.70
3. 501 - 1000 (10)	273.5000	5.70	29.0300	0.60
4. 1000+ (31)	284.6100	5.93	25.5800	0.53
Scale 2				
1. 100– (22)	51.7727	5.18	8.6461	0.86
2. 101 - 500 (30)	52.4000	5.24	10.2708	1.03
3. 501 - 1000 (10)	49.9000	4.99	8.1982	0.82
4. 1000+ (31)	52.8710	5.29	8.6938	0.87
Scale 3				
1. 100– (22)	54.3636	6.04	8.6934	0.97
2. 101 - 500 (30)	53.1333	5.90	8.3655	0.93
3. 501 - 1000 (10)	51.3000	5.70	7.0246	0.78
4. 1000+ (31)	51.2581	5.70	6.9425	0.77

Table 51. ANOVA for hypothesis 16

Variables	Variance source	Sum of squares	df	Mean square	F	Sig.
Scale 1	Between	1159.059	3	386.353	.409	.747
1. 100–	Groups					
2. 101 - 500	Within	84052.6	89	944.412		
3. 501 - 1000	Groups					
4. 1000+	Total	85211.7	92			
Scale 2	Between	71.735	3	23.912	.284	.837
1. 100–	Groups					
2. 101 - 500	Within	7501.448	89	84.286		
3. 501 - 1000	Groups					
4. 1000+	Total	7573.183	92			
Scale 3	Between	149.687	3	49.896	.806	.494
1. 100–	Groups					
2. 101 - 500	Within	5506.593	89	61.872		
3. 501 - 1000	Groups					
4. 1000+	Total	5656.280	92			

including TQM in the curriculum ($F=0.806$, $p>0.05$) did not differ significantly based on number of employees at the company. Therefore, the null hypotheses H_O 16.1, H_O 16.2, and H_O 16.3 were retained.

Summary of Hypotheses Testing (1-16)

This study was to design a survey to pursue the perceptions of instructors who taught at vocational training centers and companies' leaders that have sent their employees to centers to accept training based on eight independent variables and three dependent variables. The results of this study suggested that both VTCs' instructors and companies' leaders held positive perceptions on the three scales considered in the study, namely the core body of knowledge of TQM, TQM learning opportunities, and strategies for including TQM in the curriculum. Table 52 shows the statistical results of the positive or negative perceptions of the feasibility of implementing TQM training among VTCs' instructors, and Table 53 shows the statistical results of the significant differences of the perceptions of the feasibility of implementing TQM training among VTCs' instructors. Table 54 shows the statistical results of the positive or negative perceptions of the feasibility of implementing TQM training among companies' leaders, and Table 55 shows the statistical results of the significant differences of the perceptions of the feasibility of implementing TQM training among companies' leaders.

From Table 53, the perceptions on the core body of knowledge of TQM were significantly different based on the levels of education of VTCs' instructors. The perceptions on the strategies for including TQM in the curriculum were significantly different based on the levels of education of VTCs' instructors. The perceptions on the core body of knowledge

of TQM were significantly different based on the number of hours of TQM training of VTCs' instructors. The perceptions of VTCs' instructors on the core body of knowledge of TQM were significantly different based on the type of sponsoring agency of centers. The perceptions of VTCs' instructors on the core body of knowledge of TQM were significantly different based on location of center. The perceptions of VTCs' instructors on the TQM learning opportunities were significantly different based on location of center. The perceptions of VTCs' instructors on the strategies for including TQM in the curriculum were significantly different based on location of center. When scale 3 was transformed to be normally distributed, there were no significant differences on the perceptions of strategies for

Table 52. Summary of the statistical results of the positive or negative perceptions of the feasibility of implementing TQM training among VTCs' instructors

Variables	Core body of knowledge of TQM	TQM learning opportunities	Strategies for including TQM into curriculum
1. Job titles	**	**	**
2. Levels of education	**	**	**
3. Years of working experience	**	**	**
4. Hours of TQM training	**	**	**
5. Location	**	**	**
6. Type of training program	**	**	**
7. Type of sponsoring agency	**	**	**
8. Number of students	**	**	**

*highly positive: mean-values of item are 6.00 - 7.00
**positive: mean-values of item are 5.00 - 6.00
***neutral; mean-values of item are 4.50 - 5.00

Table 53. Summary of the statistical results of the significant differences of the perceptions of the feasibility of implementing TQM training among VTCs' instructors

Variables	Core body of knowledge of TQM	TQM learning opportunities	Strategies for including TQM into curriculum
1. Job titles			
2. Levels of education	(4)>(2) (4)>(3)		(4)>(3)
3. Years of working experience			
4. Hours of TQM training			
5. Location	(1)>(2) (1)>(3)	(1)>(2) (1)>(3)	(1)>(2) (1)>(3) (3)>(2)
6. Type of training program			
7. Type of sponsoring agency	(2)>(1)		
8. Number of students			

*numbers in parentheses represent groups (variable categories)

including TQM in the curriculum among VTCs' instructors with respect to eight independent variables.

From Table 54, the leaders having 11-15 years of working experience perceived the core body of knowledge of TQM as most important issues for VTCs. The leaders with college degrees and from the other type of product companies perceived the strategies for including TQM in the curriculum as most important issues for VTCs. For leaders from the companies that had 501-1000 employees, with bachelor's degrees, and having received 21-30

hours of TQM training, their perceptions on TQM learning opportunities were relatively neutral.

From Table 55, the perceptions on TQM learning opportunities were significantly different based on levels of education of companies' leaders. The perceptions of companies' leaders on TQM learning opportunities were significantly different based on type of product of company. When scale 3 was transformed to be normally distributed, there were no significant differences on the perceptions of strategies for including TQM in the curriculum among companies' leaders with respect to eight independent variables.

Table 54. Summary of the statistical results of the positive or negative perceptions of the feasibility of implementing TQM training among companies' leaders

Variables	Core body of knowledge of TQM	TQM learning opportunities	Strategies for including TQM into curriculum
1. Job titles	**	**	**
2. Levels of education	**	***Bachelor degree	*College degree
3. Years of working experience	*11-15 years	**	**
4. Hours of TQM training	**	***21-30 hours	**
5. Location	**	**	**
6. Type of product	**	**	*Other product
7. Type of ownership category	**	**	**
8. Number of employees	**	***501-1000 employees	**

*highly positive: mean-values of item are 6.00 - 7.00
**positive: mean-values of item are 5.00 - 6.00
***neutral; mean-values of item are 4.50 - 5.00

Table 55. Summary of the statistical results of the significant differences of the perceptions of the feasibility of implementing TQM training among companies' leaders

Variables	Core body of knowledge of TQM	TQM learning opportunities	Strategies for including TQM into curriculum
1. Job titles			
2. Levels of education		(4)>(3)	
3. Years of working experience			
4. Hours of TQM training			
5. Location			
6. Type of product			
7. Type of ownership category			
8. Number of employees			

*numbers in parentheses represent groups (variable categories)

Tests of Hypotheses (17-19)

This section examined the hypotheses of equal means for populations sampled from centers and companies on each of three scales of the instrument. To complete these analyses, a single multivariate analysis of covariance was performed with the inclusion of three separate analyses of covariance. The multivariate test was for the equality of centroids defined by the scales 1 through 3. The F-test estimated from Wilk's Lambda statistic was utilized at the 95% confidence level. The F-test was also utilized for the three separate analyses of covariance for test of equality of the scale means. In both the multivariate analyses and univariate analyses, the covariates selected were demographic data common to both centers' and companies' respondents. These were:

(1) Levels of education;

(2) Years of working experience;

(3) Hours of training in TQM; and

(4) Size of organization as measured by number of students or number of employees.

Hypothesis 17

H_O 17: There are no significant differences in scale 1 between the VTCs' instructors and companies' leaders.

It is hypothesized that the adjusted means in scale 1 for all VTCs' instructors do not differ from the adjusted means in scale 1 for all companies' leaders beyond that expected due to random sampling error as tested at the 95% confidence level. An analysis of covariance was utilized to test the differences between means adjusted by their regression on four covariates: year of working experience, size of organization (number of students or number of employees), hours of TQM training, and levels of education. Table 56 below presents the results of the analysis of covariance for scale 1 differences between VTCs' instructors and companies' leaders. Table 57 below presents the observed means and adjusted means when comparing VTCs' instructors with companies' leaders.

For analysis of covariance, the process was to first predict the dependent variable by multiple regression using the covariates as predictors. These predicted scores (predicted scale scores for example) were subtracted from the observed scores. The differences called the residual or adjusted scores ($y' = y - y\hat{}$), were analyzed by regular ANCOVA methods. From Table 56, the null hypothesis H_O 17 was rejected. Therefore, VTCs' instructors and companies' leaders differed significantly (at the .05 level) on the perceptions of core body

Table 56. ANCOVA for hypothesis 17

		United method					
Variables		Sum of squares	df	Mean square	F	Sig.	B
Scale 1 Covariates	(Combined)	34194.9	4	8548.731	5.455	.000	
	Years	10037.3	1	10037.3	6.405	.012	-4.258
	Size	65.266	1	65.266	.042	.838	.386
	Hours	6259.491	1	6259.491	3.994	.046	3.615
	Degree	22519.4	1	22519.4	14.369	.000	11.462
Main effects	Subjects	7660.088	1	7660.088	4.888	.028*	
Model		50992.4	5	10198.5	6.507	.000	
Residual		686434	438	1567.202			
Total		737427	443	1664.620			

Table 57. Descriptive statistics for hypothesis 17

Scale 1 subjects (N)	Observed mean	Adjusted mean	Observed score standard deviation
VTCs' instructors (351)	266.100	267.623	42.61
Companies' leaders (93)	281.215	279.691	30.43
Total (444)	269.270	.....	40.80

Scale 1 subjects (N)	Observed mean (item)	Adjusted mean (item)	Observed score standard deviation (item)
VTCs' instructors (351)	5.54	5.58	0.89
Companies' leaders (93)	5.86	5.83	0.63
Total (444)	5.61	.....	0.85

of knowledge of TQM when the effects of years of working experience, size of organization, hours of TQM training, and levels of education were controlled.

From Table 57, the observed mean for the VTCs' instructors was 5.54 and for the companies' leaders was 5.86. The adjusted mean for VTCs' instructors was 5.58 and for the companies' leaders was 5.83. The adjusted mean revealed that companies' leaders rated

more positively than the VTCs' instructors did on the perceptions of core body of knowledge of TQM when the four covariates were controlled.

Hypothesis 18

H_O18: There are no significant differences in scale 2 between the VTCs' instructors and companies' leaders.

It is hypothesized that the adjusted means in scale 2 for all VTCs' instructors do not differ from the adjusted means in scale 2 for all companies' leaders beyond that expected due to random sampling error as tested at the 95% confidence level. An analysis of covariance was utilized to test the differences between means adjusted by their regression on four covariates: year of working experience, size of organization (number of students or number of employees), hours of TQM training and levels of education. Table 58 below presents the results of the analysis of covariance for scale 2 differences between VTCs' instructors and companies' leaders. Table 59 below presents the observed means and adjusted means when comparing VTCs' instructors with companies' leaders.

For analysis of covariance, the process was to first predict the dependent variable by multiple regression using the covariates as predictors. These predicted scores (predicted scale scores for example) were subtracted from the observed scores. The differences called the residual or adjusted score ($y' = y - \hat{y}$), were analyzed by regular ANCOVA methods. From Table 58, the null hypothesis H_O 18 was retained. Therefore, VTCs' instructors and companies' leaders did not differ significantly (at the .05 level) on the perceptions of TQM learning opportunities when the effects of years of working experience, size of organization, hours of TQM training, and levels of education were controlled.

Table 58. ANCOVA for hypothesis 18

		United method					
Variables		Sum of squares	df	Mean square	F	Sig.	B
Scale 2 Covariates	(Combined)	549.554	4	137.389	1.446	.218	
	Years	333.969	1	333.969	3.515	.061	-.777
	Size	6.516	1	6.516	.069	.794	.122
	Hours	54.166	1	54.166	.570	.451	.336
	Degree	239.650	1	239.650	2.522	.113	1.182
Main effects	Subjects	95.991	1	95.991	1.010	.315	
Model		587.131	5	117.426	1.236	.291	
Residual		41621.2	438	95.026			
Total		42208.3	443	95.278			

Table 59. Descriptive statistics for hypothesis 18

Scale 2 subjects (N)	Observed mean	Adjusted mean	Observed score standard deviation
VTCs' instructors (351)	52.8550	53.173	9.9423
Companies' leaders (93)	52.1400	51.822	9.0729
Total (444)	52.7050	.....	9.7611

Scale 2 subjects (N)	Observed mean (item)	Adjusted mean (item)	Observed score standard deviation (item)
VTCs' instructors (351)	5.29	5.32	0.99
Companies' leaders (93)	5.21	5.18	0.91
Total (444)	5.27	.....	0.98

From Table 59, the observed mean for the VTCs' instructors was 5.29 and for the companies' leaders was 5.21. The adjusted mean for the VTCs' instructors was 5.32 and for the companies' leaders was 5.18. The adjusted mean revealed that the perceptions of both instructors and leaders on TQM learning opportunities were positive when the four covariates were controlled.

Hypothesis 19

H_O 19: There are no significant differences in scale 3 between the VTCs' instructors and companies' leaders.

It is hypothesized that the adjusted means in scale 3 for all VTCs' instructors do not differ from the adjusted mean in scale 3 for all companies' leaders beyond that expected due to random sampling error as tested at the 95% confidence level. An analysis of covariance was utilized to test the differences between means adjusted by their regression on four covariates: year of working experience, size of organization (number of students or number of employees), hours of TQM training and levels of education. Table 60 below presents the results of the analysis of covariance for scale 3 differences between VTCs' instructors and companies' leaders. Table 61 below presents the observed means and adjusted means when comparing VTCs' instructors with companies' leaders.

For analysis of covariance, the process was to first predict the dependent variables by multiple regression using the covariates as predictors. These predicted scores (predicted scale scores for example) were subtracted from the observed scores. The differences called the residual or adjusted score ($y' = y - \hat{y}$), were analyzed by regular ANCOVA methods. From Table 60, the null hypothesis H_O 19 was retained. Therefore, VTCs' instructors and companies' leaders did not differ significantly (at the .05 level) on the perceptions of strategies for including TQM in the curriculum when the effects of years of working experience, size of organization, hours of TQM training, and levels of education were controlled.

Table 60. ANCOVA for hypothesis 19

		United method					
Variables		Sum of squares	df	Mean square	F	Sig.	B
Scale 3 Covariates	(Combined)	941.072	4	235.268	3.052	.017	
	Years	131.668	1	131.668	1.708	.192	-.488
	Size	7.977	1	7.977	.103	.748	-.135
	Hours	27.702	1	27.702	.359	.549	.240
	Degree	813.619	1	813.619	10.554	.001	2.179
Main effects	Subjects	266.962	1	266.962	3.463	.063	
Model		1267.283	5	253.457	3.288	.006	
Residual		33767.0	438	77.093			
Total		35034.2	443	79.084			

Table 61. Descriptive statistics for hypothesis 19

Scale 3 subjects (N)	Observed mean	Adjusted mean	Observed score standard deviation
VTCs' instructors (351)	50.4960	50.422	9.1107
Companies' leaders (93)	52.6020	52.675	7.8410
Total (444)	50.9369	.....	8.8929

Scale 3 subjects (N)	Observed mean (item)	Adjusted mean (item)	Observed score standard deviation (item)
VTCs' instructors (351)	5.61	5.60	1.01
Companies' leaders (93)	5.84	5.85	0.87
Total (444)	5.66	.....	0.99

From Table 61, the observed mean of the VTCs' instructors was 5.61 and for the companies' leaders was 5.84. The adjusted mean for VTCs' instructors was 5.60 and for the companies' leaders was 5.85. The adjusted mean revealed that the perceptions of both instructors and leaders on strategies for including TQM in the curriculum were highly positive when the four covariates were controlled.

Hypothesis for Testing the Adjusted Centroids

It is hypothesized that the adjusted centroids defined by the means in scales 1, 2, and 3 for VTCs' instructors do not differ significantly from the adjusted centroids defined by the means in scales 1, 2, and 3 for companies' leaders beyond that expected due to random sampling error as tested at the 95% confidence level. A multivariate analysis of covariance (MANCOVA) was utilized to test the hypothesis. The four covariates utilized were years of working experience, size of organization (number of students or number of employees), hours of TQM training and levels of education. Table 62 below presents the results of the multivariate analysis of covariance in scales 1, 2, and 3 for VTCs' instructors and companies' leaders.

From Table 62, the above results were consistent with results obtained for Hypothesis 17, Hypothesis 18, and Hypothesis 19, but provided additional evidence that VTCs' instructors and companies' leaders differed significantly in the multivariate space defined by all three scales concurrently. While only scale 1 was significant at the .05 level, with a p-value of .028, the multivariate difference between the centroids was significant at the .001 level.

Summary of Hypotheses Testing (17-19)

When the four covariates of years of work experience, size of organization, hours of TQM training, and levels of education were controlled, the perceptions on the core body of knowledge (scale 1) between VTCs' instructors and companies' leaders were significantly different, the companies' leaders rated more positively than the VTCs' instructors did on

Table 62. MANCOVA in scales 1, 2, and 3 for VTCs' instructors and companies' leaders (N=444)

Multivariate tests of significance (S = 1, M = ½, N = 217)

Test name	Value	Exact F	Hypoth. DF	Error DF	Sig. of F
Pillais	.03858	5.83151	3.00	436.00	.001
Hotellings	.04013	5.83151	3.00	436.00	.001
Wilks	.96142	5.83151	3.00	436.00	.001
Roys	.03858				

Note F statistic are exact

Univariate F-tests with (1,438) D. F.

Variable	SS	Error SS	MS	Error MS	F	Sig. of F
Scale 1	7660.088	686434.283	7660.088	1567.202	4.88775	.028
Scale 2	95.991	41621.2183	95.991	95.026	1.01016	.315
Scale 3	266.962	33766.9513	266.962	77.094	3.46284	.063

Variables-scale 1

Cell	Obs. mean	Adj. mean	Est. mean	Raw resid.	Std. resid
1	266.100	267.623	266.100	.000	.000
2	281.215	279.691	281.215	.000	.000

Variables-scale 2

Cell	Obs. mean	Adj. mean	Est. mean	Raw resid.	Std. resid
1	52.855	53.173	52.855	.000	.000
2	52.140	51.822	52.140	.000	.000

Variable-scales 3

Cell	Obs. mean	Adj. mean	Est. mean	Raw resid.	Std. resid
1	50.496	50.422	50.496	.000	.000
2	52.602	52.675	52.602	.000	.000

the perceptions of core body of knowledge of TQM. However, there were no significant differences on the perceptions of TQM learning opportunities (scale 2) and strategies for including TQM in the curriculum (scale 3) between the two groups. When scale 3 was transformed to be normally distributed, there were no significant differences on the perceptions of strategies for including TQM in the curriculum between the two groups, too.

The adjusted mean revealed that the perceptions of both instructors and leaders on all three scales were positive.

Exploratory Factor Analyses

To examine the validity of the three sub-scales as measures of the different perceptions of the feasibility of TQM training at VTCs in Taiwan, R. O. C., several analyses were performed. A Principal Axis Factor Analysis (Common Factor Analysis Model) was completed using the SPSS for Windows package. Communalities were initially estimated by squared multiple correlation of each item in the instrument with the remaining items. Factors corresponding to eigenvalues of 1.0 or greater were rotated to the Varimax criterion. Examination of the resulting factors in terms of their relationships to the three sub-scales was performed by ordering items based on the size of the factor loadings on the items and examining the content of the items loading on each factor and the primary sub-scales or sub-scales from which they were obtained. Attempts were made to label each factor by the predominant communality of the content of those items on a factor. By this means, the researcher hoped to identify key concept clusters that might explain differences observable among subgroups with centers or companies as well as differences that might be observed between VTCs' instructors and companies' leaders.

The exploratory factor analysis revealed nine factors based on eigenvalues greater than 1.0. These nine factors combined accounted for 65% of the total variance. The Factor Scree Plot and nine factor-loadings on the 67 items were as shown in Figure 8 and Table 63.

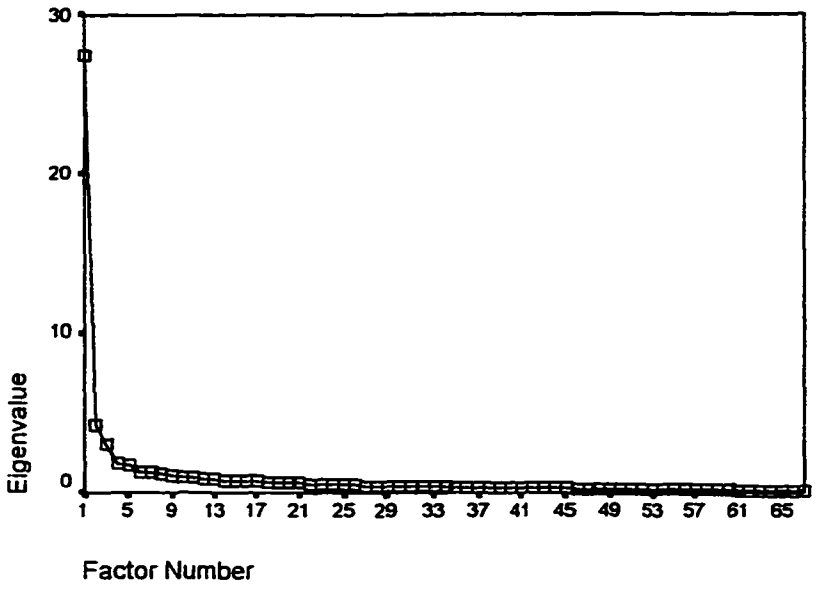


Figure 8. Factor scree plot

Factor-loadings exceeding + 0.30 only are reported in the Table 63. The exploratory analysis provided the underlying structure of the instrument and identified the nine factors. From Table 63, a study of the items within the individual clusters suggested that the nine factors could be labeled as:

Factor 1: Continuous improvement, process and systems perspective.

(item 8, 11, 14, 15, 16, 17, 18. 19, 20, 21, 22, 23, 33, 34, 36, 42, 43, 44, 45, 46)

Factor 2: Teamwork and active learner.

(item 5, 6, 24, 25, 26, 27, 28, 29, 30, 31, 32, 38, 39, 40, 41, 47, 48)

Factor 3: Strategies for including TQM into curriculum.

(item 59, 60, 61, 62, 63, 64, 65, 66, 67)

Factor 4: TQM learning opportunities.

(item 49, 50, 51, 52, 53, 54, 55, 56, 57, 58)

Factor 5: Customer orientation.

(item 1, 2, 3, 4)

Factor 6: TQM tools (Quality control tools, Management and planning tools).

(item 9, 10)

Factor 7: Quality Planning and management.

(item 12, 13)

Factor 8: Definition of quality.

(item 7)

Factor 9: TQM innovativeness.

(item 35, 37)

Factors 1, 2, 5,6,7,8, and 9 were together related with the original scale 1 of the instrument, namely the core body of knowledge of TQM. Likewise, Factor 3 was related with scale 3, namely strategies for including TQM into the curriculum and Factor 4 was related with scale 2, namely instructor preferences for TQM learning opportunities. Thus, the findings of the exploratory factor analyses validated the original three sub-scales of the instrument.

It must be noted that factors 1, 2, 5, 6, 7, 8 and 9 cumulatively contained the 47 items defining the core body of knowledge of TQM. The labels for each factor were assigned based on an inspection of items in the data collection instrument; these labels were not exactly compatible with the names of the original clusters defining the core body of TQM knowledge

Table 63. Rotated factor matrix

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9
Item 18	.74177								
Item 16	.69797								
Item 36	.64232								
Item 45	.61925								
Item 43	.61075								
Item 17	.60046								
Item 14	.58724	.30457							
Item 34	.56954	.43262							
Item 23	.56638								
Item 46	.55039	.43366							
Item 22	.55020	.35750							
Item 21	.54845								
Item 20	.53618	.35348							
Item 8	.53398				.35165	.41707			
Item 33	.53364	.30220							
Item 19	.52388								
Item 15	.50911	.30754							
Item 44	.50368			.33793					
Item 35	.48998	.40145							.30413
Item 42	.48990	.44317							
Item 11	.47279	.34643							
Item 26		.75414							
Item 25		.71391							
Item 38		.68955							
Item 30		.68052							
Item 27		.67130							
Item 28		.61574							
Item 31		.59407							
Item 29	.34241	.59312							
Item 37		.58502							.35697
Item 40		.58030	.35618						
Item 32	.41799	.54069							
Item 41	.40534	.52431							
Item 5		.51817			.39068				
Item 24	.32838	.51340							
Item 12	.40682	.51278					.34822		
Item 39	.38614	.47358							
Item 48		.46036		.31018					
Item 13	.37629	.42896					.42477		
Item 6		.42359			.31898				
Item 47	.36822	.36959							
Item 65			.74420	.32284					
Item 67			.74290						
Item 63			.73483						
Item 61			.72470						
Item 66			.69870						

Table 63. Continued

Item 62			.66785						
Item 64			.66479						
Item 60			.48771	.37903					
Item 59			.46033	.34362					
Item 55				.70672					
Item 53				.69512					
Item 50				.66618					
Item 54				.65907					
Item 51				.64638					
Item 56				.63427					
Item 49			.34588	.61188					
Item 52				.58561					
Item 57				.58267					
Item 58			.35085	.53205					
Item 2		.38130			.66273				
Item 4		.43050			.60161				
Item 1		.30352			.59143				
Item 3					.47360				
Item 10	.50329					.55554			
Item 9	.51511					.53082			
Item 7	.34038				.30546	.35554		.36784	
Eigenvalue	27.47	4.34	3.11	1.92	1.74	1.35	1.30	1.25	1.07
CumPct(%)	41.00	47.50	52.10	55.00	57.60	59.60	61.50	63.40	65.00

as reported in the Procter and Gamble Company (1992) study (see Chapter three). For example, the study from the Procter and Gamble Company (1992) indicated that items 7-12 belonged to a single cluster of "TQM tools". However, based on factor analyses in this study, just items 9 and 10 (Factor 6) belonged to the cluster of "TQM tools". In the study from the Procter and Gamble Company (1992), items 1- 6 belonged to a single cluster labeled "customer orientation", only items 1- 4 (Factor 5) emerged as related to "customer orientation" in the exploratory factor analyses conducted in this study. Fundamentally, the TQM learning opportunities (Factor 4) and strategies for including TQM into curriculum (Factor 3) taken as a whole emerged as two major factors consistent with the reported

findings in the Procter and Gamble Company (1992) study. Construct validity as verified by exploratory analysis further demonstrated the usefulness of the instrument.

Pearson Product-Moment correlation were computed and tested with a two-tailed t-test at the 95% confidence level among three sub-scales and nine factors scores of the instrument, and the ordinal measures of levels of education, years of working experience, hours of training in TQM, and size of organization (number of students or number of employees) which were demographic data common to both centers and companies respondents. In particular, the researcher desired to demonstrate that the nine factor scores obtained by linear regression means were, in fact, correlated near zero as they should be if orthogonal factors were obtained. In addition, it was desired to know the degree of relationship among the three sub-scales as well as among the factor scores. The latter provided additional information for labeling the factors and validating the constructs of the original three sub-scales of the instrument.

From Table 64, the correlation between factor 1 and scale 1 was 0.668; between factor 2 and scale 1 was 0.613; between factor 4 and scale 2 was 0.914; and between factor 3 and scale 3 was 0.875. These values reflected a high degree of correlation. There were significant correlation between each of scales 1, 2, and 3 and each of factors 1, 2, 3, 4, and 5. There was a significant correlation between scale 1 and factor 6. There were significant differences between levels of education and factor 2, scale 1, and scale 3. There were significant differences between hours of TQM training and factor 1, factor 8, and scale 1. There were significant differences between number of working experience and factor 2, factor 8, and scale 1.

Table 64. Correlation and two-tailed t - test among scales, factors, and covariates

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9
Levels of education	.076	.101*	.085	.049	-.064	-.035	-.082	.055	.034
Hours of TQM training	.103*	.056	.025	-.047	.086	.063	.062	-.150*	-.019
Size of organization	.042	-.088	-.031	.008	-.005	-.025	.006	.039	-.079
Years of working experience	-.079	-.106*	-.050	.008	-.067	-.098	-.069	.140**	-.001
Scale 1	.668**	.613**	.276**	.271**	.336**	.188**	.050	.025	.074
Scale 2	.244**	.191**	.317**	.914**	.104*	.089	.020	.013	.026
Scale 3	.218**	.284**	.875**	.364**	.153**	.055	.062	.014	.054

* $p < 0.05$ ** $p < 0.01$

Variables	Scale 1	Scale 2	Scale 3
Levels of education	.116*	.073	.116*
Hours of TQM training	.119*	.010	.047
Size of organization	-.034	-.002	-.043
Years of working experience	-.142**	-.062	-.082

* $p < 0.05$ ** $p < 0.01$

CHAPTER 5. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Within the preceding chapters the problem of the study, purpose, literature review, methodology, data analysis, and finding were presented. The purpose of this chapter is to present a summary of the previous chapters, draw conclusions, findings related to previous studies, make recommendations and propose future research based on the findings of the study.

Summary

Vocational training centers (VTCs) in Taiwan had not included TQM methodologies in their training curriculum. This placed the trainers, skilled workers in manufacturing, and service personnel in Taiwanese enterprises at a disadvantage in a globally competitive economy. This study employed a paper and pencil instrument to survey the instructors working in the thirteen vocational training centers and the leaders in the companies that sent their employees to vocational training centers. There were approximately 500 instructors in the thirteen vocational training centers (an entire population was sent a questionnaire), including Full instructors, Associate instructors, and Assistant instructors. Companies' leaders including President, Vice President, and Manager were identified in the approximately 150 companies (companies were selected as a purposive non-random sample). The study assumed that the VTCs' instructors and companies' leaders had basic understanding of the terminology of Total Quality Management. The original instrument in English was translated correctly to obtain an equivalent Chinese version.

The primary purposes of this study were to identify the degree of importance of

teaching an established core body of knowledge in TQM concepts and skills to trainees who attend the vocational training centers, to find the level of preference for potential learning opportunities to improve instructors' knowledge of TQM principles and methods, and to express the degree of agreement with strategies that might be used to include TQM practices in the VTCs curriculum. The instrument addressed three major constructs, including core body of knowledge of TQM, instructors' preference for TQM learning opportunities, and strategies for including TQM in the curriculum. Previously developed questionnaire and research finding in related studies were examined closely to verify if appropriate models for the proposed instrument could be identified.

The iterative process employed in designing the attitudinal measures of the instrument culminated in 67 items, of which 48, 10, and 9 items represented the constructs of core body of knowledge of TQM, TQM learning opportunities, and strategies for including TQM into curriculum respectively. Besides these 67 items, a section on demographic data was included as part of the instrument. This section provided data related to the 16 independent variables: job titles, levels of education, years of working experience, hours of training of TQM, location, type of training programs at the centers, type of sponsoring agency of the centers, numbers of students at the centers, job titles, levels of education, years of working experience, hours of training of TQM, location, type of products at the companies, type of ownership category of the companies, and number of employees at the companies.

A knowledgeable panel of Chinese and American experts assisted in establishing the content validity of the instrument. A translation from the English to Chinese instrument was completed and submitted to national TQM experts for verification. A pilot test verified the

clarity and readability of the instrument. Before actual data collection began, the Human Subjects Review Committee approved the study. The number of surveys returned from VTCs' instructors was 365 out of the original 500 that were mailed; 95 out of 150 companies that received the surveys were represented in the participating sample. There were respondents that could be considered as outliers or individuals that did not follow directions or attend to the task with seriousness; a total of 16 subjects from the original pool of respondents were thus eliminated, leaving a total sample of 444 observations.

Data collected through the surveys were subjected to a comprehensive statistical analysis using the Statistical Package for the Social Science (SPSS) applications software. Both descriptive and inferential analyses were conducted. The items were ordered by means and standard deviations to indicate high and low importance. Reliabilities of three constructs and the entire instrument were estimated. Construct validity was established using a Principal Axis Factor Analysis, and each of the nineteen original research hypotheses enlisted at the beginning of the study was tested at the 95% confidence level.

To test the hypotheses, one-way analyses of variance (ANOVA) were conducted at the 95% confidence level. Scheffe' post-hoc comparisons among groups were also performed at the 95% confidence level in order to determine which, if any, simple contrasts among groups were significant. To examine the hypotheses of equal means for populations sampled from centers and companies on each of three scales of the instruments, a single multivariate analysis of covariance was performed with the inclusion of three separate analyses of covariance.

Conclusions

The findings of the study, which presented in chapter 4, are summarized by: (a) demographic characteristics of respondents, (b) item analysis, (c) reliability of the instrument, (d) tests of hypotheses, and (e) exploratory analyses.

Demographic Characteristics of Respondents

The total number of instructors at centers responding to the survey was 351, of which 11(3.13%) were full instructors, 187 (53.28%) associate instructors, and 153 (43.59%) assistant instructors. More instructors reported having a college degree (58.69%) than any other education level. Most instructors had 15 or more years of experience (52.42%). A large number of instructors (74.36%) reported having had less than 10 hours quality training. There were more centers (69.52%) at other cities than at Taipei or at Kaoshiung. A large number of centers (86.04%) reported having had skilled worker training programs. Most centers were sponsored by government agencies (94.87%). A majority of the centers have enrolled between 101-500 students (51.28%).

The total number of leaders at companies responding to the survey was 93, of which 3 (3.22%) were presidents, 5 (5.38%) vice-presidents, 30 (32.26%) managers, and 55 (59.14%) others. This number was higher for persons occupying lower leadership positions than for higher leadership positions. More leaders reported having a bachelor's degree (51.61%) than any other education level. Most leaders had less than 5 years of experience (53.76%). A large number of leaders (36.56%) reported having had 30 or more hours of quality training. There were more companies (68.82%) at other cities than at Taipei or Kaoshiung. A large number of companies (74.19%) reported having manufacturing products.

Most companies were owned by common stock (82.8%). A majority of companies have employed 1000 or more people (33.33%).

Item Analyses

To identify individual items indicating high and low importance, the items were ordered by the means and standard deviations obtained on the 444 respondents. The items with the ten highest means were items 25 (teamwork and people involvement), 2 (understanding customer expectations and requirements), 5 (measurement of customer satisfaction), 30 (consensus development), 38 (knowledge of oneself), 31 (continuous improvement), 40 (personal commitment and responsibility), 37 (development of new knowledge), 32 (product design for quality), and 4 (proactively seeking feedback from customers); all these items represented elements in the core body of knowledge of TQM (scale 1). Considering that the measurement scale employed an interval from 1-7, the fact that the top ten values for the mean ranged from 5.93 to 6.14 reflected a high degree of importance for the core body of knowledge of TQM.

The items with the ten lowest means (ranging from 4.89 to 5.27) were items 23 (difference between common and special causes), 50 (senior faculty member on loan), 53 (TQM institute), 54 (TQM partnerships), 33 (difference between small and large quality improvement), 3 (difference between internal and external customers), 18 (operational definition), 44 (quality award criteria), 55 (conferences), and 43 (theory of constraints). Most of these items were associated with potential TQM learning opportunities (scale 2) for instructors at vocational training centers.

The total mean of core body of knowledge of TQM, which included 48 items, was 5.61. The total mean of instructor preferences for TQM learning opportunities, which included 10 items, was 5.27. The total mean of strategies for including TQM in the curriculum, which included 9 items, was 5.66. The results suggested that was a strong need to teach TQM knowledge and skills at vocational training centers. The perceptions of preferences for TQM learning opportunities were not as high as the perceived importance of core body of knowledge of TQM. The perceptions of strategies for including TQM in the curriculum were highly positive; therefore these strategies deserved strong consideration.

Reliability of the Instrument

The reliability of the overall instrument was estimated as 0.9773. Scale 1 (core body of knowledge of TQM) had the highest reliability (0.9745) and scale 2 (instructor preferences for TQM learning opportunities) had the lowest reliability (0.9094). The reliability of the overall instrument and the three major scales could be considered sufficiently high for continued use in practical application.

Tests of Hypotheses

Nineteen hypotheses were tested and this section summarizes the results of the tests. Hypotheses 1-16 (each included 3 hypotheses) were tested using the one-way analysis of variance (ANOVA) procedure with the Scheffe' post-hoc procedure. Hypotheses 17-19 (each included 3 hypotheses) were tested using a single multivariate analysis of covariance (MANCOVA) with the inclusion of three separate analyses of covariance (ANCOVA). In both the multivariate analyses and univariate analyses, the covariates selected were demographic data common to both centers' and companies' respondents. These were:

(a) levels of education; (b) years of working experience; (c) hours of TQM training; and (d) size of organization as measured by number of students at centers or number of employees at companies. All hypotheses were tested at the .05 level of significance. Out of the fifty-one hypotheses that were tested, ten were rejected and forty-one were retained.

Hypothesis 1

H_O 1.1: There are no significant differences in scale 1 among instructors at VTCs as a function of job titles (retained).

H_O 1.2: There are no significant differences in scale 2 among instructors at VTCs as a function of job titles (retained).

H_O 1.3: There are no significant differences in scale 3 among instructors at VTCs as a function of job titles (retained).

The mean values for the three scales of instructors holding Full, Associate, and Assistant titles ranged from 5.23 to 5.73. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of instructors on the core body of knowledge of TQM ($F=0.849$, $p>0.05$), TQM learning opportunities ($F=0.900$, $p>0.05$), and strategies for including TQM into the curriculum ($F=0.122$, $p>0.05$) did not differ significantly based on job titles. The null hypotheses H_O 1.1, H_O 1.2, and H_O 1.3 were retained.

Hypothesis 2

H_O 2.1: There are no significant differences in scale 1 among instructors at VTCs as a function of levels of education (rejected).

H_O 2.2: There are no significant differences in scale 2 among instructors at VTCs as a function of levels of education (retained).

H_O 2.3: There are no significant differences in scale 3 among instructors at VTCs as a function of levels of education (rejected).

The mean values for the three scales of instructor holding Master's, Bachelor's, and other degrees ranged from 5.08 to 5.74. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of instructors on the core body of knowledge of TQM ($F = 6.657$, $p < 0.05$) and strategies for including TQM in the curriculum ($F = 3.850$, $p < 0.05$) were all significantly different based on levels of education. Therefore, the null hypotheses H_O 2.1 and H_O 2.3 were rejected.

The Scheffe' post-hoc statistic revealed that the group with college degree rated more positively than the group with Bachelor's degree did and the group with Master's degree did in their perceptions on the core body of knowledge of TQM. The group with college degree rated more positively than the group with Bachelor's degree did in their perceptions on the strategies for including TQM in the curriculum. However, the perceptions of instructors on the TQM learning opportunities ($F=0.270$, $p>0.05$) did not differ significantly based on the levels of education. The null hypothesis H_O 2.2 was retained.

Hypothesis 3

H_O 3.1: There are no significant differences in scale 1 among instructors as a function of years of working experience at the center (retained).

H_O 3.2: There are no significant differences in scale 2 among instructors as a function of years of working experience at the center (retained).

H_O 3.3: There are no significant differences in scale 3 among instructors as a function of years of working experience at the center (retained).

The mean values for the three scales of instructors having 0-5, 6-10, 11-15, and 15+ years of working experience ranged from 5.17 to 5.73. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of instructors on the core body of knowledge of TQM ($F=0.868$, $p>0.05$), TQM learning opportunities ($F=1.894$, $p>0.05$), and strategies for including TQM in the curriculum ($F=0.452$, $p>0.05$) did not differ significantly based on years of working experience. Therefore, the null hypotheses H_O 3.1, H_O 3.2, and H_O 3.3 were retained.

Hypothesis 4

H_O 4.1: There are no significant differences in scale 1 among instructors at VTCs as a function of number of hours of TQM training received (rejected).

H_O 4.2: There are no significant differences in scale 2 among instructors at VTCs as a function of number of hours of TQM training received (retained).

H_O 4.3: There are no significant differences in scale 3 among instructors at VTCs as a function of number of hours of TQM training received (retained).

The mean values for the three scales of instructors having 0-10, 11-20, 21-30 and 30+ hours of TQM training ranged from 5.19 to 6.04. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of instructors on the core body of knowledge of TQM ($F=2.836$, $p<0.05$) were significantly different based on the number of hours of TQM training received. Therefore, the null hypothesis H_O 4.1 was rejected. However, the perceptions of TQM learning opportunities

(F=0.729, p>0.05) and strategies for including TQM in the curriculum (F=1.709, p>0.05) did not differ significantly based on the hours of TQM training received. The null hypotheses H_O 4.2 and H_O 4.3 were retained.

Hypothesis 5

H_O 5.1: There are no significant differences in scale 1 among instructors as a function of location of vocational training center (rejected).

H_O 5.2: There are no significant differences in scale 2 among instructors as a function of location of vocational training center (rejected).

H_O 5.3: There are no significant differences in scale 3 among instructors as a function of location of vocational training center (rejected).

The mean values for the three scales of instructors at Taipei, Kaoshiung and other cities ranged from 5.06 to 6.19. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of instructors on the core body of knowledge of TQM ($F = 13.478$, $p < 0.05$), TQM learning opportunities ($F = 5.996$, $p < 0.05$), and strategies for including TQM in the curriculum ($F = 13.551$, $p < 0.05$) were all significantly different based on location of vocational training center. Therefore, the null hypotheses H_O 5.1, H_O 5.2, and H_O 5.3 were rejected.

The Scheffe' post-hoc statistic revealed that instructors at Taipei rated more positively than their colleagues at Kaoshiung did and at other cities did in their perceptions on all the three scales considered. Instructors at other cities rated more positively than their colleagues at Kaoshiung did in their perceptions on the strategies for including TQM in the curriculum.

Hypothesis 6

H_O 6.1: There are no significant differences in scale 1 among instructors as a function of type of training program of vocational training center (retained).

H_O 6.2: There are no significant differences in scale 2 among instructors as a function of type of training program of vocational training center (retained).

H_O 6.3: There are no significant differences in scale 3 among instructors as a function of type of training program of vocational training center (retained).

The mean values for the three scales of instructors in skilled worker, skilled worker and teacher training programs ranged from 5.27 to 5.71. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of instructors on the core body of knowledge of TQM ($F=0.013$, $p>0.05$), TQM learning opportunities ($F=0.651$, $p>0.05$), and strategies for including TQM in the curriculum ($F=0.521$, $p>0.05$) did not differ significantly based on the type of training program. Therefore, the null hypotheses H_O 6.1, H_O 6.2, and Ho 6.3 were retained.

Hypothesis 7

H_O 7.1: There are no significant differences in scale 1 among instructors as a function of type of sponsoring agency of vocational training center (rejected).

H_O 7.2: There are no significant differences in scale 2 among instructors as a function of type of sponsoring agency of vocational training center (retained).

H_O 7.3: There are no significant differences in scale 3 among instructors as a function of type of sponsoring agency of vocational training center (retained).

The mean values for the three scales of instructors in government, non-government agency ranged from 5.27 to 6.05. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of instructors on the core body of knowledge of TQM ($F=6.142$, $p<0.05$) were significantly different based on the type of sponsoring agency. Therefore, the null hypothesis H_O 7.1 was rejected.

The mean values revealed that non-government sponsored instructors rated more positively than government sponsored instructors did in their perceptions on the core body of knowledge of TQM. However, the perceptions of instructors on TQM learning opportunities ($F=2.484$, $p>0.05$) and strategies for including TQM into the curriculum ($F=2.912$, $p>0.05$) did not differ significantly based on the type of sponsoring agency. The null hypotheses H_O 7.2 and H_O 7.3 were retained.

Hypothesis 8

H_O 8.1: There are no significant differences in scale 1 among instructors as a function of number of students of vocational training center (retained).

H_O 8.2: There are no significant differences in scale 2 among instructors as a function of number of students of vocational training center (retained).

H_O 8.3: There are no significant differences in scale 3 among instructors as a function of number of students of vocational training center (retained).

The mean values for the three scales of instructors from different size centers ranged from 5.15 to 5.73. Therefore, it could be concluded that instructors' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of instructors on the core body of knowledge of TQM ($F=0.757$, $p>0.05$), TQM learning opportunities ($F=0.294$, $p>0.05$), and

strategies for including TQM into the curriculum (F=0.184, p>0.05) did not differ significantly based on number of students of vocational training center. Therefore, the null hypotheses H_O 8.1, H_O 8.2, and H_O 8.3 were retained.

Hypothesis 9

H_O 9.1: There are no significant differences in scale 1 among leaders at companies as a function of job titles (retained).

H_O 9.2: There are no significant differences in scale 2 among leaders at companies as a function of job titles (retained).

H_O 9.3: There are no significant differences in scale 3 among leaders at companies as a function of job titles (retained).

The mean values for the three scales of leaders holding President, Vice-President, Manager and other titles ranged from 5.07 to 5.97. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of leaders on the core body of knowledge of TQM (F=1.218, p>0.05), TQM learning opportunities (F=0.030, p>0.05), and strategies for including TQM in the curriculum (F=1.631, p>0.05) did not differ significantly based on job titles. Therefore, the null hypotheses H_O 9.1, H_O 9.2, and H_O 9.3 were retained.

Hypothesis 10

H_O 10.1: There are no significant differences in scale 1 among leaders at companies as a function of levels of education (retained).

H_O 10.2: There are no significant differences in scale 2 among leaders at companies as a function of levels of education (rejected).

H_O 10.3: There are no significant differences in scale 3 among leaders at companies as a function of levels of education (retained).

The mean values for the three scales of leaders holding Doctorate, Master, Bachelor and other degrees ranged from 5.00 to 6.20. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of leaders on TQM learning opportunities ($F = 2.985$, $p < 0.05$) were significantly different based on levels of education. Therefore, the null hypothesis H_O 10.2 was rejected.

The Scheffe' post-hoc statistic revealed that the group with college degree rated more positively than the group with Bachelor's degree did in their perceptions on TQM learning opportunities. However, the perceptions of leaders on the core body of knowledge of TQM ($F=0.572$, $p>0.05$) and strategies for including TQM in the curriculum ($F=2.629$, $p>0.05$) did not differ significantly based on the levels of education. The null hypotheses H_O 10.1 and H_O 10.2 were retained.

Hypothesis 11

H_O 11.1: There are no significant differences in scale 1 among leaders as a function of years of working experience at the company (retained).

H_O 11.2: There are no significant differences in scale 2 among leaders as a function of years of working experience at the company (retained).

H_O 11.3: There are no significant differences in scale 3 among leaders as a function of years of working experience at the company (retained).

The mean values for the three scales of leaders having 0-5, 6-10, 11-15, 15+ years of working experience ranged from 5.00 to 6.20. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of leaders on the core body of knowledge of TQM ($F=2.486$, $p>0.05$), TQM learning opportunities ($F=1.431$, $p>0.05$), and strategies for including TQM in the curriculum ($F=2.253$, $p>0.05$) did not differ significantly based on number of years of working experience at the companies. Therefore, the null hypotheses H_O 11.1, H_O 11.2, and H_O 11.3 were retained.

Hypothesis 12

H_O 12.1: There are no significant differences in scale 1 among leaders at companies as a function of number of hours of TQM training received (retained).

H_O 12.2: There are no significant differences in scale 2 among leaders at companies as a function of number of hours of TQM training received (retained).

H_O 12.3: There are no significant differences in scale 3 among leaders at companies as a function of number of hours of TQM training received (retained).

The mean values for the three scales of leaders having 0-10, 11-20, 21-30, 30+ hours of TQM training ranged from 4.59 to 6.12. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of leaders on the core body of knowledge of TQM ($F=0.860$, $p>0.05$), TQM learning opportunities ($F=1.948$, $p>0.05$), and strategies for including TQM in the curriculum ($F=2.563$, $p>0.05$) did not differ significantly based on number of hours of TQM training received. Therefore, the null hypotheses H_O 12.1, H_O12.2, and H_O 12.3 were retained.

Hypotheses 13

H_O 13.1: There are no significant differences in scale 1 among leaders as a function of location of company (retained).

H_O 13.2: There are no significant differences in scale 2 among leaders as a function of location of company (retained).

H_O 13.3: There are no significant differences in scale 3 among leaders as a function of location of company (retained).

The mean values for the three scales of leaders at Taipei, Kaoshiung and other cities ranged from 5.04 to 5.92. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of leaders on the core body of knowledge of TQM ($F=0.602$, $p>0.05$), TQM learning opportunities ($F=0.220$, $p>0.05$), and strategies for including TQM in the curriculum ($F=2.879$, $p>0.05$) did not differ significantly based on location of the company. Therefore, the null hypotheses H_O 13.1, H_O 13.2, and H_O 13.3 were retained.

Hypothesis 14

H_O 14.1: There are no significant differences in scale 1 among leaders as a function of type of product of the company (retained).

H_O 14.2: There are no significant differences in scale 2 among leaders as a function of type of product of the company (rejected).

H_O 14.3: There are no significant differences in scale 3 among leaders as a function of type of product of the company (retained).

The mean values for the three scales of leaders from manufacturing, service, both and other type of companies ranged from 5.00 to 6.93. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of leaders on TQM learning opportunities ($F=2.723$, $p<0.05$) were significantly different based on type of products. Therefore, the null hypothesis H_O 14.2 was rejected. However, the perceptions of leaders on core body of knowledge of TQM ($F=1.569$, $p>0.05$) and strategies for including TQM in the curriculum ($F=2.044$, $p>0.05$) did not differ significantly based on type of products. The null hypotheses H_O 14.1 and H_O 14.3 were retained.

Hypothesis 15

H_O 15.1: There are no significant differences in scale 1 among leaders as a function of type of ownership category of the company (retained).

H_O 15.2: There are no significant differences in scale 2 among leaders as a function of type of ownership category of the company (retained).

H_O 15.3: There are no significant differences in scale 3 among leaders as a function of type of ownership category of the company (retained).

The mean values for the three scales of leaders for wholly owned, common stock companies ranged from 5.19 to 5.90. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of leaders on the core body of knowledge of TQM, ($F=0.065$, $p>0.05$), TQM learning opportunities ($F=0.287$, $p>0.05$), and strategies for including TQM in the curriculum ($F=2.050$, $p>0.05$) did not differ significantly based on ownership category. Therefore, the null hypotheses H_O 15.1, H_O 15.2, and H_O 15.3 were retained.

Hypothesis 16

H_O 16.1: There are no significant differences in scale 1 among leaders as a function of number of employees at the company (retained).

H_O 16.2: There are no significant differences in scale 2 among leaders as a function of number of employees at the company (retained).

H_O 16.3: There are no significant differences in scale 3 among leaders as a function of number of employees at the company (retained).

The mean values for the three scales of leaders from different size companies ranged from 4.99 to 6.04. Therefore, it could be concluded that leaders' perceptions were positive with respect to scales 1, 2, and 3. The perceptions of leaders on the core body of knowledge of TQM ($F=0.409$, $p>0.05$), TQM learning opportunities ($F=0.284$, $p>0.05$), and strategies for including TQM in the curriculum ($F=0.806$, $p>0.05$) did not differ significantly based on number of employees at the company. Therefore, the null hypotheses H_O 16.1, H_O 16.2, and H_O 16.3 were retained.

Summary of Hypotheses Testing (1-16)

This study was to design a survey to pursue the perceptions of instructors who taught at vocational training centers and leaders at companies that have sent their employees to centers to accept training based on eight independent variables and three dependent variables. The results of this study suggested that both instructors at VTCs and leaders at companies held positive perceptions on the three scales considered in the study, namely the core body of knowledge of TQM, TQM learning opportunities, and strategies for including TQM in the curriculum.

The perceptions on the core body of knowledge of TQM were significantly different based on the levels of education of instructors at VTCs. The perceptions on the strategies for including TQM in the curriculum were significantly different based on the levels of education of instructors at VTCs. The perceptions on the core body of knowledge of TQM were significantly different based on the number of hours of TQM training of instructors at VTCs. The perceptions of instructors at VTCs on the core body of knowledge of TQM were significantly different based on the type of sponsoring agency of centers. The perceptions of instructors at VTCs on the core body of knowledge of TQM were significantly different based on location of center. The perceptions of instructors at VTCs on the TQM learning opportunities were significantly different based on location of center. The perceptions of instructors at VTCs on the strategies for including TQM in the curriculum were significantly different based on location of center.

The leaders having 11-15 years of working experience at company (mean value=6.20) perceived the core body of knowledge of TQM as most important issues for VTCs. The leaders with college degrees (mean value=6.20) and from the other type of product companies (mean value=6.93) perceived the strategies for including TQM in the curriculum as most important issues for VTCs. For leaders from the companies that had 501-1000 employees (mean value=4.99), with a bachelor's degrees (mean value=4.99), and having received 21-30 hours of TQM training (mean value=4.59), their perceptions on TQM learning opportunities were relatively neutral. The perceptions on TQM learning opportunities were significantly different based on levels of education of leaders at companies. The perceptions of leaders at

companies on TQM learning opportunities were significantly different based on type of product of company.

Hypothesis 17

H_O 17: There are no significant differences in scale 1 between the instructors at VTCs and leaders at companies (rejected).

The instructors and leaders differed significantly (at the .05 level) on the perceptions of core body of knowledge of TQM when the effects of years of working experience, size of organization (number of students or number of employees), hours of TQM training, and levels of education were controlled. Therefore, the null hypothesis H_O 17 was rejected. The observed mean for the instructors was 5.54 and for the leaders was 5.86. The adjusted mean for instructors was 5.58 and for the leaders was 5.83. The adjusted mean revealed that leaders rated more positively than the instructors did on the perceptions of core body of knowledge of TQM when the four covariates were controlled.

Hypothesis 18

H_O 18: There are no significant differences in scale 2 between the instructors at VTCs and leaders at companies (retained).

The instructors and leaders did not differ significantly (at the .05 level) on the perceptions of TQM learning opportunities when the effects of years of working experience, size of organization (number of students or number of employees), hours of TQM training, and levels of education were controlled. Therefore, the null hypothesis H_O 18 was retained. The observed mean for the instructors was 5.29 and for the leaders was 5.21. The adjusted

mean for instructors was 5.32 and for the leaders was 5.18. The adjusted mean revealed that the perceptions of both instructors and leaders on TQM learning opportunities were positive when the four covariates were controlled.

Hypothesis 19

H_O 19: There are no significant differences in scale 3 between the instructors at VTCs and leaders at companies (retained).

The instructors and leaders did not differ significantly (at the .05 level) on the perceptions of strategies for including TQM in the curriculum when the effects of years of working experience, size of organization (number of students or number of employees), hours of TQM training, and levels of education were controlled. Therefore, the null hypothesis H_O 19 was retained. The observed mean of the instructors was 5.61and for the leaders were 5.84. The adjusted mean for instructors was 5.60 and for the leaders was 5.85. The adjusted mean revealed that the perceptions of both instructors and leaders on strategies for including TQM in the curriculum were highly positive when the four covariates were controlled.

Hypothesis for Testing the Adjusted Centroids

It is hypothesized that the adjusted centroids defined by the means in scales 1, 2, and 3 for instructors at VTCs do not differ significantly from the adjusted centroids defined by the means in scale 1, 2, and 3 for leaders at companies beyond that expected due to random sampling error as tested at the 95% confidence level.

The results were consistent with results obtained for Hypothesis 17, Hypothesis 18, and Hypothesis 19, but provided additional evidence that instructors and leaders differed significantly in the multivariate space defined by all three scales concurrently. While only scale 1 was significant at the .05 level, with a p-value of .028, the multivariate difference between the centroids was significant at the .001 level.

Summary of Hypotheses Testing (17-19)

When the four covariates of years of work experience, size of organization, hours of TQM training, and levels of education were controlled, the perceptions on the core body of knowledge (scale 1) between the instructors at VTCs and leaders at companies were significantly different, the leaders rated more positively than the instructors did on the perceptions of core body of knowledge of TQM. However, there were no significant differences on the perceptions of TQM learning opportunities (scale 2) and strategies for including TQM in the curriculum (scale 3) between the two groups. The adjusted mean revealed that the perceptions of both instructors and leaders on all three scales were positive.

Exploratory Factor Analyses

To examine the validity of the three scales as measures of the different perceptions of the feasibility of TQM training at VTCs in Taiwan, R.O.C., a Principal Axis Factor Analysis (Common Factor Analysis Model) was completed using the SPSS for Windows package. Communalities were initially estimated by squared multiple correlation of each item in the instrument with the remaining items. Factors corresponding to eigenvalues of 1.0 or greater were rotated to the Varimax criterion. The results of the exploratory analysis revealed in nine

factors, which accounted for 65% of the total variance. The results suggested that the three original a-priori dimensions might be increased to nine factors. The nine factors could be labeled as: (1) continuous improvement, process and systems perspective; (2) teamwork and active learner; (3) strategies for including TQM into curriculum; (4) TQM learning opportunities; (5) customer orientation; (6) TQM tools (quality control tools, management and planning tools); (7) quality planning and management; (8) definition of quality; and (9) TQM innovativeness.

Factors 1, 2, 5, 6, 7, 8, and 9 were together related with the original scale 1 of the instrument, namely the core body of knowledge of TQM. Likewise, Factor 3 was related with scale 3, namely strategies for including TQM in the curriculum, and Factor 4 was related with scale 2 , namely instructor preferences for TQM learning opportunities.

Pearson Product-Moment correlation were computed and tested with a two-tailed t-test at the 95% confidence level among three scales and nine factors scores of the instrument, and the ordinal measures of levels of education, years of working experience, hours of TQM training, and size of organization (number of students or number of employees) which were demographic data common to both centers and companies respondents.

The correlation between factor 1 and scale 1 was 0.668; between factor 2 and scale 1 was 0.613; between factor 4 and scale 2 was 0.914; and between factor 3 and scale 3 was 0.875. These values reflected a high degree of correlation. There were significant correlation between each of scales 1, 2, and 3 and each of factors 1, 2, 3, 4, and 5. There was a significant correlation between scale 1 and factor 6. There were significant differences

between levels of education and factor 2, scale 1, and scale 3. There were significant differences between hours of TQM training and factor 1, factor 8, and scale 1. There were significant differences between number of working experience and factor 2, factor 8, and scale 1. The results of the exploratory analyses provided the information for labeling the factors, validating the constructs of the original three scales of the instrument, and suggested that further revision of the instrument was necessary.

Finally, the findings of this study could provide some indication as to whether the vocational training system in Taiwan, R.O.C. is in favor of Total Quality Management. The relatively high mean scores on the strategies for including TQM in the curriculum and the core body of knowledge of TQM suggest that there exist a favorable perceptions for quality implementation efforts. This favorable perceptions, as expressed by leaders at companies and instructors at centers in Taiwan, suggest that quality implementation efforts have a high feasibility of success.

Findings Related to Previous Research

Although the specific questions of the instrument in this study were being addressed for the first time, it was noted that several findings and conclusions were in convergence with the reported works of somewhat closely related studies. The overall findings related to the importance of core body of knowledge of TQM, TQM learning opportunities, and strategies for including TQM into the curriculum were fundamentally in agreement with the findings reported in the Procter and Gamble study conducted in the United States (The Procter & Gamble Company, 1992).

The Employers' Needs Working Council in the Procter and Gamble study (The Procter & Gamble Company, 1992) reported that eight clusters of TQM knowledge and skills were essential for all college/university graduates. The eight clusters identified in the Procter and Gamble report have also formed the basis for more recent studies in total quality education (Evans, 1996; Weinstein et al., 1998). Through their ratings on the elements of core body of knowledge of TQM, the instructors at VTCs and the leaders at companies in Taiwan have basically agreed on the importance of the concepts and ideas contained in the eight clusters.

Jang (1992) conducted a study on critical success factors in the implementation of TQM in Taiwan, R.O.C. The critical six successful factors to implement TQM in business and industry were identified as leadership commitment, concept of total quality, quality policy deployment, employee participation, infrastructure, and systems approach. The core body of knowledge of TQM identified in the current study was consistent with the above factors of concept of total quality, quality policy deployment, and the systems approach in the thirty related items mentioned in the Jang (1992) study.

The Total Quality Faculty Development Working Council in the Procter and Gamble study determined that American university deans have perceived that TQM learning opportunities involving industry personnel or active faculty interaction with industry were most effective (The Procter & Gamble Company, 1992). Through their ratings of very similar learning opportunities, the instructors at VTCs and the leaders at companies in Taiwan were in agreement with the findings of the Procter and Gamble study.

The ratings of TQM learning opportunities in this study although positive, were not as high as the ratings of the core body of knowledge of TQM. This suggested that the subjects in this study might have alternative opportunities that they perceived would be better ways to learn TQM knowledge and skills. Cultural and societal differences between the peoples of the United States and Taiwan could play a key role in determining the preferences for TQM learning opportunities.

Pan (1996) conducted a study that focused on TQM in Taiwan's vocational training system and reported that administrators, faculty, and staff believed in the introduction of TQM-based administration at the VTCs. In the opinion of the subjects in his study, vocational training system did not foresee any problems in implementing TQM. The current study reinforced that the instructors at VTCs held a positive attitude toward continuing education and teaching TQM to their trainees. It might be concluded that administrators in Taiwan's vocational training system should initiate opportunities for the instructors to enhance their knowledge of TQM concepts and build related teaching skills.

The Total Quality Curricula, Materials, and Programs Working Council in the Procter and Gamble study (The Procter & Gamble Company, 1992) identified six strategies for including TQM into the American college/university curriculum. The same six strategies were high-positively rated by the instructors at VTCs and the leaders at companies. The American study noted that these six strategies were by no means exhaustive.

Tseng (1995) conducted a study investigating the course design of TQM. These courses were specifically intended for students enrolled in engineering departments in Taiwanese universities. According to this study, response to future needs of industry and

teacher was an important driving force in curriculum design. The study also reported that all stakeholders including faculty, students, and industry representatives must all be involved during the stages of TQM curriculum design. These ideas were included in instrument employed in the current study; subsequently, the analysis of responses from the instructors at VTCs and the leaders at companies revealed agreement with the Tseng (1995) study.

Further, a exploratory analysis of the instrument of this study yielded nine factors that were consistent with the findings reported in the American study (The Procter & Gamble Company, 1992). However, certain differences were observable in the individual factors and these were documented in detail earlier in chapter 4.

Recommendations

The results of this study suggested that both the instructors at VTCs and the leaders at companies held positive perceptions on the three scales considered in the study, namely the core body of knowledge of TQM, TQM learning opportunities, and strategies for including TQM into curriculum. The Council of Labor Affairs, which is the major sponsoring agency of the vocational training system in Taiwan, should become aware of the findings in this study and plan on implementing TQM theories and methodologies at VTCs. During the policy planning cycle for the next fiscal year, the sponsoring agencies should consider the dimension of TQM implementation in vocational training system, such as to allocate appropriate funding to make curriculum changes, and provide opportunities to learn TQM for instructors lacking of TQM training.

Leadership commitment is very important for implementing successful TQM in vocational training programs. Directors and administrators of the vocational training centers

should communicate with leaders of industrial and business enterprises and universities faculty, and be willing to receive guidance and exchange information from them.

Estimates of central tendency from the item analysis of the instrument, the following ten items of core body of knowledge of TQM were rated most highly positive by the instructors at VTCs and the leaders at companies: (a) teamwork and people involvement; (b) understanding customer expectations and requirements; (c) measurement of customer satisfaction; (d) consensus development; (e) knowledge of oneself; (f) continuous improvement; (g) personal commitment and responsibility; (h) development of new knowledge; (i) product design for quality; and (j) proactively seeking feedback from customers.

Companies' leaders rated more positively than VTCs' instructors did on the perceptions of core body of knowledge of TQM. There were significant differences on perceptions of core body of knowledge of TQM among VTCs' instructors with respect to levels of education, hours of TQM training, location of center, and type of sponsoring agency of center. The leaders having 11-15 years of working experience perceived the core body of knowledge as most importance issues for VTCs.

The instructors should take initiative to prepare to teach the ten core body of knowledge of TQM to the trainees, to buy TQM related instructional materials for the classroom, to avail of TQM opportunities, and to become involved with quality-related professional organizations.

This study highlighted the importance of strategies for including TQM into curriculum. There were significant differences on strategies for including TQM into

curriculum among the instructors with respect to levels of education and location of centers. The leaders with college degree and from the other type of product of company perceived the strategies for including TQM into curriculum as most important issues for VTCs.

The Employment and Vocational Training Administration, which is the major sponsoring agency of the vocational training centers, should offer TQM courses at VTCs and provide incentives for individual employees to obtain professional certifications in quality methodologies. Currently, companies bear the burden of education their employees to obtain certifications from the Chinese Society for Quality. Shifting this burden from companies to government will encourage more employees to pursue certification programs.

There were significant differences on the perceptions of TQM learning opportunities among companies' leaders with respect to levels of education and type of product of company. There were significant differences on the perceptions of TQM learning opportunities among VTCs' instructors with respect to location of center.

Companies should become proactive in partnering with vocational training centers in providing TQM learning opportunities for the instructors at VTCs. This is particularly important as several companies already have exposure to TQM. As a whole, companies have endorsed the view that vocational training centers should teach TQM knowledge and skills to their employees. It is reasonable to expect business and industry of Taiwan to become more actively involved and extend full co-operation with vocational training centers in implementing TQM theories and methodologies. It is worthy to note here that in the United States several industry-academy partnerships emerged during the 1980s and 90s. Many companies played a

major role in making TQM education become increasingly popular in academic institutions within the United States.

Further Research

As a follow-up of the present study, immediate research should focus on interviewing experts and scholars of vocational training system in Taiwan, R.O.C., and seek their opinions regarding the finding from the study. Their familiarity with the wide range of impacting elements that influence the vocational training system should enable an assessment of changes that can be implemented as a result of the present study. The specific cultural, societal, technical, and financial factors associated with the vocational training system in Taiwan are well understood by people who have an in-depth knowledge of the system; therefore this proposed follow-up presents an excellent opportunity for further research.

The perceptions of strategies for including TQM into the curriculum were highly positive; therefore these strategies deserved strong consideration. For example, the strategy requiring the creation of interdisciplinary teams to teach quality to trainees was rated as important; however, this might be difficult to implement in practice. Further research should address how this might be done under the existing conditions at the vocational training centers in Taiwan.

The study of literature revealed that curriculum design integrating TQM has been developed for university and college students. However, no such studies have been completed for the students at VTCs. Therefore, curriculum models that integrate TQM should be developed specifically for vocational training centers. Administrators and faculty

from universities could provide valuable assistance in researching the integration of TQM concepts into the vocational training centers' curriculum.

This study was to design a survey to pursue the perceptions of instructors who taught at vocational training centers and the leaders at companies that have sent their employees to centers to accept training based on eight independent variables and three dependent variables. Future research should gather the perceptions of people holding administration positions in vocational training system. Representation from the companies could include personnel at the middle and junior levels of management and quality divisions. Such studies would provide the finding to draw comparisons between closely affiliated groups such as administrators and instructors, or manufacturing company personnel versus service company personnel.

Most of leaders represented in this study were from small- or medium-scale companies. Further research should include people from large-scale enterprises; a random sample may be taken. The study of literature revealed that the extent of TQM practice in Taiwanese companies varied considerably. Therefore, further research should be directed toward making comparisons between industries that have considerable experience with TQM versus those that have little or no such exposure.

As the reliability of the entire instrument and the three major scales was estimated to be high, the exploratory analysis verified the construct validity and identified nine factors for the underlying structure of the instrument. This instrument is satisfactory for repeated use and should be applied in future research. For example, this instrument could be utilized in investigating the elements of implementing TQM theories and methodologies at the community colleges in the United States.

Yet another recommendation for further research relates to the method of data collection. The President and Vice-President of companies demonstrated little willingness to respond to a written survey instrument. Alternate methods of collecting data from this group of professionals must be adopted in further research. Other methods for data collection such as personal interviews might be better suited for data collection. Further, this study was based on quantitative techniques; future studies could employ qualitative methods of research.

Vocational training centers in Taiwan should introduce the core body of knowledge of TQM in their training curriculum in the future, preferably on a small scale. Following this, a follow-up research would be to verify if the changes impacted the effectiveness of the training programs. This method would closely follow the Plan-Do-Check-Act (PDCA) quality improvement methodology first proposed by Walter Shewhart and later strongly recommended by Dr. Deming for all quality practitioners (Gelina, 1993).

Another suggestion for future research would be to investigate different methods of instruction for teaching TQM at VTCs in Taiwan. One method might use traditional classroom techniques (lecture, discussion, handout, exams) and alternative methods might employ experiential on-site training methods and/or multi-media training systems. Modern methods of instruction include self-paced courses using multi-media technology. A comparative study of the effectiveness of different instructional methods could provide important insights for improved training in various aspects related to the core body of knowledge of TQM.

APPENDIX A

LIST OF PANEL MEMBERS

Instrument Validation Members (Chinese)

NAME	POSITION/TITLE	INSTITUTION
Dr. Chang, T.	Asst Prof	Industrial Education and Technology, ISU
Dr. Hsu, K. Y.	Adj Prof	Aerospace Engineering and Engineering Mechanics, ISU
Dr. Kao, T.	Prof	Civil and Construction Engineering, ISU
Dr. Wong, K. F.	Assoc Prof	Marketing, ISU
Dr. Yang, Y.	Asst Prof	Statistics, ISU

Instrument Validation Members (American)

NAME	POSITION/TITLE	INSTITUTION/COMPANY
Dr. Berger, R. W.	Prof	Industrial and Manufacturing Systems Engineering, ISU
Mr. Bjelland, D. L.	Program Coord	Facilities Planning and Management, ISU
Dr. Chacko, T. I.	Prof	Management, ISU
Dr. Hetland, P. W.	Manager TQM	Business and Finance Administration, ISU
Mr. Loecke, R.	Associate	Center for Continuous Quality Improvement, Research Park at ISU
Dr. Zeimet, D.E.	Safety Science Program Coord	Des Moines Area Community College

APPENDIX B

CHINESE VERSION OF INSTRUMENT

我國職業訓練系統全面品質管理推行可行性之調查研究

敬啓者：

我是美國愛荷華州立大學工業教育系博士候選人，博士論文研究題目爲「對我國職業訓練系統推行全面品質管理理論與概念之可行性調查」。研究結果將提供我國政府及企業界作爲未來規劃及改進勞工訓練課程的重要參考。本問卷之目的在於瞭解您的寶貴意見，對於職業訓練制度課程規劃及改進亦將有很大的幫助。本問卷僅提供資料分析之用，第二部份題目採用中英文對照方式，翻譯方式力求精簡確實。請於填答後轉交發件人，由其統籌將本問卷寄回。非常謝謝您的協助！

敬祝

福祺

研究主持人　　指導教授　　指導教授

王秦希康　　羅伯葛林納　　羅傑史密斯 敬上

地址：台北市連雲街
47 巷 1-2 號 3
樓

電話：23932136

中華民國八十七年七月二十一日

題目：我國職業訓練系統推行全面品質管理理論與概念之調查研究。
對象：(1)十三處職業訓練中心之教師（正、副、助理訓練師）。
(2)送其員工參與職訓中心訓練課程的公司或工廠之主管人員（總經理、副總經理及廠長等）。

問卷調查表有三大部分：
(1) 要求問卷人員回答「全面品質管理的知識及技能對職訓中心學員的重要性」(1=很不重要，7=很重要)。
(2) 要求問卷人員回答「職訓中心教師學習及改進全面品質管理知識之方式」(1=最不優先，7=最優先)。
(3) 要求問卷人員回答「職訓中心將全面品質管理納入課程設計及修訂之策略」(1=非常不同意，7=非常同意)。

填問卷表注意事項：
(1) 本問卷之填答採不記名方式。
(2) 您的背景資料部份可直接答在問卷表上第一部份。
(3) 問卷表上第二、三及四部份共有 67 題，則答在 NCS Score Sheet 右邊上。
(4) 每一題目只圈選一個答案 (1 至 7)，請依您的瞭解詳細填答。
(5) 所有問卷答案保密，最後結果是整體性分析。問卷之密碼用來追蹤及增加回應率。
(6) 填答問卷表後，請密封寄回研究人員。

謝謝您的協助及合作，您的參與對本研究將有莫大的貢獻。若您對問卷調查有任何的疑義，請惠予指教！

請就您認爲最適當的答案在□上打 v ，如選擇「其他」，請將您的情況或觀點寫在橫線上。

第一部份：職業訓練老師之背景資料。請直接答在問卷表上。
(1) 我工作職稱是：
□正訓練師 □副訓練師 □助理訓練師 □其他_____
(2) 我的學歷背景是：
□博士 □碩士 □學士 □其他_____
(3) 我在職訓中心工作年資是：
□0-5 年 □6-10 年 □11-15 年 □超過 15 年_____
(4) 在過去五年我參加全面品質管理訓練時數是：
□0-10 小時 □11-20 小時 □21-30 小時 □超過 30 小時____
(5) 我職訓中心地點在：
□縣_____ □市_____
(6) 我職訓中心提供訓練課程是：
□技術員訓練課程 □師資訓練課程 □兩種訓練課程
□其他_____
(7) 我職訓中心資助機構是：
□政府機構 □非政府機構
(8) 我職訓中心的學員有：
□ 0-100 人 □101-500 人 □501-1000 人 □超過 1000 人_____

請繼續填答第二、三及四部份，並請將答案答在 NCS Score Sheet 右邊上。

題目：我國職業訓練系統推行全面品質管理理論與概念之調查研究。
對象：(1)十三處職業訓練中心之教師（正、副、助理訓練師）。
(2)送其員工參與職訓中心訓練課程的公司或工廠之主管人員（總經理、副總經理及廠長等）。

問卷調查表有三大部分：
(1)要求問卷人員回答「全面品質管理的知識及技能對職訓中心學員的重要性」（1=很不重要，7=很重要）。
(2)要求問卷人員回答「職訓中心教師學習及改進全面品質管理知識之方式」（1=最不優先，7=最優先）。
(3)要求問卷人員回答「職訓中心將全面品質管理納入課程設計及修訂之策略」（1=非常不同意，7=非常同意）。

填問卷表注意事項：
(1)本問卷之填答採不記名方式。
(2)您的背景資料部份可直接答在問卷表上第一部份。
(3)問卷表上第二、三及四部份共有 67 題，則答在 NCS Score Sheet 右邊上。
(4)每一題目只圈選一個答案（1 至 7），請依您的瞭解詳細填答。
(5)所有問卷答案保密，最後結果是整體性分析。問卷之密碼用來追蹤及增加回應率。
(6)填答問卷表後，請密封寄回研究人員。

謝謝您的協助及合作，您的參與對本研究將有莫大的貢獻。若您對問卷調查有任何的疑義，請惠予指教！

請就您認爲最適當的答案在□上打 v ，如選擇「其他」，請將您的情況或觀點寫在橫線上。

第一部份：工廠或公司之主管人員背景資料。請直接答在問卷表上。
(1) 我工作職稱是：
□總經理 □副總經理 □廠長 □其他_____
(2) 我的學歷背景是：
□博士 □碩士 □學士 □其他_____
(3) 我在公司（或工廠）工作年資是：
□0-5 年 □6-10 年 □11-15 年 □超過 15 年_____
(4) 在過去五年我參加全面品質管理訓練時數是：
□0-10 小時 □11-20 小時 □21-30 小時 □超過 30 小時____
(5) 我公司（或工廠）地點在：
□縣_____ □市_____
(6) 我公司（或工廠）產品是：
□製造業 □服務業 □兩者 □其他_____
(7) 我公司（或工廠）資產是：
□自己擁有 □股份有限公司
(8) 我公司（或工廠）員工人數有：
□0-100 人 □101-500 人 □501-1000 人 □超過 1000 人_____

請繼續填答第二、三及四部份，並請將答案答在 NCS Score Sheet 右邊上。

第二部份：職訓中心的學員具備全面品質管理知識和技能。請您就下列 1 至 48 個題目圈選您認爲是適當的乙項（1=很不重要，7=很重要），請您將答案直接寫在 NCS Score Sheet 右邊上。

(1)確認顧客
Identifying customers

很不重要						很重要
1	2	3	4	5	6	7

(2)瞭解顧客之期待與要求
Understanding customer expectations and requirements

很不重要						很重要
1	2	3	4	5	6	7

(3)內在與外在顧客的區分
Difference between internal and external customers

很不重要						很重要
1	2	3	4	5	6	7

(4)積極瞭解顧客需求及回饋
Proactively seeking feedback from customers

很不重要						很重要
1	2	3	4	5	6	7

(5)顧客滿意度之評估
Measurement of customer satisfaction

很不重要						很重要
1	2	3	4	5	6	7

(6)員工滿意與顧客滿意之關連性
Relationship between employee satisfaction and customer satisfaction

很不重要						很重要
1	2	3	4	5	6	7

(7)依據專家學者的看法，確定「品質」的定義
Definitions of quality according to experts and scholars

很不重要						很重要
1	2	3	4	5	6	7

(8)「統計製程管制」工具之選擇
Selection of statistical process control tools

很不重要						很重要
1	2	3	4	5	6	7

(9)品管七大手法，例如柏拉圖、直方圖、特性要因圖等
Quality control tools (Pareto diagram, Cause-and-effect diagram,Histogram, etc.)

很不重要						很重要
1	2	3	4	5	6	7

(10)品管新七大手法，例如箭形圖、樹形圖、矩陣圖等
Management and planning tools (Arrow diagram, Tree diagram, Matrix diagram, etc.)

很不重要						很重要
1	2	3	4	5	6	7

(11)實驗設計
Design of experiments

很不重要						很重要
1	2	3	4	5	6	7

(12)成本制管理的概念
Activity-based cost management concepts

很不重要						很重要
1	2	3	4	5	6	7

(13)P(計劃)D(執行)C(考核)A(行動)之循環
Plan-do-check-act cycle

很不重要						很重要
1	2	3	4	5	6	7

(14)瞭解變異性質
Understanding variation

很不重要						很重要
1	2	3	4	5	6	7

(15)「品質」成本，例如預防成本，鑑定成本及失敗成本等
Cost of quality (Prevention cost, Appraisal cost, Failure cost, etc.)

很不重要						很重要
1	2	3	4	5	6	7

(16)根因分析法
Root-cause analysis

很不重要						很重要
1	2	3	4	5	6	7

(17)認識資料數據之類型及其涵義
Recognizing data patterns and their implications

很不重要						很重要
1	2	3	4	5	6	7

(18)操作型定義（乃指該項定義可以藉由如何評量此觀念及在何種情況下應用此觀念來界定之）
Operational definition (A definition that gives communicable meaning by specifying how the concept is measured and applied within a set of circumstances)

很不重要						很重要
1	2	3	4	5	6	7

(19)強調「製程或服務流程」的觀念而不是「產品」的觀念
Concepts focusing on process rather than product

很不重要						很重要
1	2	3	4	5	6	7

(20)流程圖與製程或服務流程的製圖
Flowcharting and process mapping

很不重要						很重要
1	2	3	4	5	6	7

(21)品質之設計與品質之檢驗的區分
Difference between building in quality and inspecting in quality

很不重要						很重要
1	2	3	4	5	6	7

(22)製程或服務流程之評量
Measuring processes

很不重要						很重要
1	2	3	4	5	6	7

(23)共同原因與特殊原因之區分
Difference between common and special causes

很不重要						很重要
1	2	3	4	5	6	7

(24)製程管制之觀念
Process control concepts

很不重要						很重要
1	2	3	4	5	6	7

(25)團隊合作與員工參與
Teamwork and people involvement

很不重要						很重要
1	2	3	4	5	6	7

(26)領導之技巧
Leadership skills

很不重要						很重要
1	2	3	4	5	6	7

(27)團隊建立之技巧
Team-building skills

很不重要						很重要
1	2	3	4	5	6	7

(28)團隊集會之技巧
Team-meeting (facilitation) skills

很不重要						很重要
1	2	3	4	5	6	7

(29)員工授權
Employee empowerment

很不重要						很重要
1	2	3	4	5	6	7

(30)共識之凝聚
Consensus development

很不重要						很重要
1	2	3	4	5	6	7

(31)持續改善
Continuous improvement

很不重要						很重要
1	2	3	4	5	6	7

(32)產品「品質」之設計
Product design for quality

很不重要						很重要
1	2	3	4	5	6	7

(33)小的改善與大的改善之區分
Difference between small and large quality improvements

很不重要						很重要
1	2	3	4	5	6	7

(34)製程或服務流程設計與再設計的重要性
Important of design and re-design of processes

很不重要						很重要
1	2	3	4	5	6	7

(35)持續改善與全球性競爭之關係
Relationship between continuous improvement and global competition

很不重要						很重要
1	2	3	4	5	6	7

(36)跨機能別之互動
Cross-functional interaction

很不重要						很重要
1	2	3	4	5	6	7

(37)最新知識的發展
Development of new knowledge

很不重要						很重要
1	2	3	4	5	6	7

(38)自我認知
Knowledge of oneself

很不重要						很重要
1	2	3	4	5	6	7

(39)組織變遷之調適
Dealing with organizational change

很不重要						很重要
1	2	3	4	5	6	7

(40)個人承諾與責任
Personal commitment and responsibility

很不重要						很重要
1	2	3	4	5	6	7

(41)瞭解學習的型式
Understanding learning styles

很不重要						很重要
1	2	3	4	5	6	7

(42)系統思考
Systems thinking

很不重要						很重要
1	2	3	4	5	6	7

(43)限制理論
Theory of constrains

很不重要						很重要
1	2	3	4	5	6	7

(44)「品質」獎之標準，例如 Baldridge 獎、戴明獎等
Quality Award criteria (Baldrige Award, Deming Prize, etc.)

很不重要						很重要
1	2	3	4	5	6	7

(45)組織任務之敘述
Organizational mission statement

很不重要						很重要
1	2	3	4	5	6	7

(46)組織目標與成果
Organizational goals and outcomes

很不重要						很重要
1	2	3	4	5	6	7

(47)ISO（國際標準組織）9000 品質保證體系
ISO 9000 standards for quality systems

很不重要						很重要
1	2	3	4	5	6	7

(48)您認爲教導職訓中心之學員全面品質管理之知識是否重要？
How important you feel it is to teach TQM to trainees at training centers?

很不重要						很重要
1	2	3	4	5	6	7

第三部份：職訓中心教師可利用各種機會來增進他們對全面品質管理原則及方法之知識。請您就下列 49 至 58 個題目圈選您認爲最適當的乙項（1=最不優先，7=最優先），請您將答案直接寫在 NCS Score Sheet 右邊上。

(49)具有全面品質管理專業知識的企業界主管在職訓中心工作 6 到 12 個月，對職訓中心教職員提供全面品質管理的教育訓練。

最不優先 最優先

1 2 3 4 5 6 7

(50)學院或大學中具有全面品質管理實際工作經驗之高級教職員，在職訓中心工作 6 到 12 個月，對職訓中心教職員提供全面品質管理的教育訓練。

最不優先 最優先

1 2 3 4 5 6 7

(51)職訓中心教職員到實行全面品質管理成功之工廠（公司）或學院（大學）學習研究全面品質管理之應用 1 到 4 個月。

最不優先 最優先

1 2 3 4 5 6 7

(52) 3 到 5 個系列的兩小時電視廣播有關全面品質管理理念納入職訓中心課程的基本步驟之建立。

最不優先 最優先

1 2 3 4 5 6 7

(53)由全面品質管理專業社團/機構主辦一星期的集會，邀請全世界大學教職員、企業界主管或全面品質管理學者/專家作演講，題目爲「增加對全面品質管理觀念之認識及解釋全面品質管理理念納入職訓中心課程之方法」。

最不優先 最優先

1 2 3 4 5 6 7

(54)35%到 75%的職訓中心教職員訪問一家工廠（公司），每星期 4 到 5 天，目的是學習全面品質管理理念。之後建立職訓中心與工廠（公司）之間兩年期限的建教合作關係。教職員分享工廠（公司）全面品質管理教育課程，同時觀察與參與該公司全面品質管理之應用。

最不優先 最優先

1 2 3 4 5 6 7

(55)職訓中心教職員參加 200 人到 800 人之會議。此會議由高等教育機構，全面品質管理專業組織、社團及商業團體主持，目的是學習全面品質管理之理念。

最不優先 最優先

1 2 3 4 5 6 7

(56)職訓中心教職員參加 2 到 3 天學校開設之全面品質管理課程（大約 25 人參加之課程），此課程類似企業界提供其員工的課程。這些課程由工廠（公司）、專業社團或顧問公司提供給企業界員工的課程。

最不優先 最優先

1 2 3 4 5 6 7

(57)研究講習會由全面品質管理專業社團/機構主持。特別的講題是「全面品質管理策略計劃、現行課程內容、團隊工作之發展方法、品質標誌、品質標竿以及履行原則」。

最不優先 最優先

1 2 3 4 5 6 7

(58)出版職訓中心教職員全面品質管理資源指南手冊，包括課程綱目、題材、閱讀及教學筆記等。此手冊代表高等教育及企業界學習全面品質管理之門徑。

最不優先 最優先

1 2 3 4 5 6 7

第四部份：職業訓練中心利用各種策略將全面品質管理理論及概念納入課程中。請您就下列 59 到 67 個題目圈選您認爲最適當的一個答案(1=非常不同意，7=非常同意)，請您將答案直接寫在 NCS Score Sheet 右邊上。

(59)教導「品質」的內涵應該整合在單一的學科和全部的課程中。

非常不同意 1 2 3 4 5 6 7 非常同意

(60)職訓中心教師應該加強各學科間的教職員團隊工作來教導學生「品質」之課程。

非常不同意 1 2 3 4 5 6 7 非常同意

(61)「品質」原則之應用應該包括：從行政功能的不斷改善到課程發展過程的不斷改善，再應用到教室的教學方式之不斷改善。

非常不同意 1 2 3 4 5 6 7 非常同意

(62)職訓中心應該建立「品質改善團隊」來提供訓練課程之不斷改善措施。

非常不同意 1 2 3 4 5 6 7 非常同意

(63)職訓中心應該視那些送其員工到職訓中心受訓之公司（或工廠）爲他們的顧客，同時尋求公司（或工廠）的回饋而不斷改善其課程。

非常不同意 1 2 3 4 5 6 7 非常同意

(64)課程修訂應該涵蓋探討學生、家長、社會、校友會、雇主及教職員的需求之研究。

非常不同意 1 2 3 4 5 6 7 非常同意

(65)職訓中心課程發展之有關人員，包括教師、職員及學生，都必須從開始即主動地參與「全面品質管理」的學習過程。

非常不同意 1 2 3 4 5 6 7 非常同意

(66)最重要關鍵的是要有堅強而完全投入的領導者，職訓中心才能成功地完成「全面品質管理」的課程發展。

非常不同意 1 2 3 4 5 6 7 非常同意

(67)預估及回應企業界未來需求的過程，才是課程發展之最重要任務。

非常不同意 1 2 3 4 5 6 7 非常同意

填表日期：____年____月____日

再次感謝您！

APPENDIX C

COVER LETTER FOR PILOT TEST

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Education

Departmental of Industrial
Education and Technology
114 I. Ed. II
Ames, Iowa 50011 - 3130
(515)294-1033
Fax (515)294-1123

July 3, 1998
[Name]
[Address]
[City, State, Zip Code]

Dear [Name]:

Thank you for agreeing to participate in this research study. As stakeholders in the future of Taiwanese business and industry, we hope that you agree that vocational training programs for current and future employees in industries needs continuous improvement. This research is primarily aimed at understanding the perceptions of the feasibility of total quality management (TQM) education to trainees that attend courses conducted by vocational training centers (VTCs). The population in this research will consist of instructors who teach at the VTCs and the leadership of companies that have recently sent their employees to the VTCs for training.

With this letter you should receive an instrument that is designed for data collection. This instrument is a preliminary version. We need your help in completing a pilot test that would improve the readability and clarity of the instrument before actually using it for data collection. Please note that there are three parts in the instrument:

Part 1. Respondents will be asked to rate how important it is for trainees who attend the VTCs' courses to acquire specific TQM related knowledge, using a seven-point scale (1= not important, 7= very important).
Part 2. Respondents will be asked to rate their preferences on learning opportunities for instructors who teach the VTCs' courses to improve their knowledge of TQM principles and methods, using a seven-point scale (1= low preference, 7= high preference).
Part 3. Respondents will be asked to rate their agreements on several strategies for including TQM practices into VTCs' curriculum, using a seven-point scale (1= strongly disagree, 7= strongly agree).

Please read the instrument and indicate your response item by item. If any item or instruction is not clear to you, please note your comments on this booklet itself. Please note that there are no correct or wrong answers because the answers reflect individual opinions only.

Your participation is entirely voluntary. The response you provide will be kept confidential and only reported in a collective form. After the analysis is complete, the booklet will be

destroyed to further preserve the confidentiality. Therefore, please be encouraged to provide honest responses and comments to improve the readability and clarity of this instrument.

We sincerely appreciate your active contribution in this research effort that could have a significant impact in the vocational training centers' curriculum.

Sincerely,

Hsi-Kong Chin Wang
Principal Investigator
Tel: (515) -292-3014
E-Mail: hchin@iastate.edu

Dr. Robert J. Gelina
Co-Major Professor
Tel: (515)-296-9796
Fax: (515)-296-9910

Dr. Roger A. Smith
Co-Major Professor
Tel: (515)-294-2539
Fax: (515)-294-1123

APPENDIX D

REVISED INSTRUMENT

Total Quality Management Feasibility Instrument

Wang, Hsi-Kong Chin
Department of Industrial Education and Technology
Iowa State University

This instrument is designed to measure your perceptions regarding the feasibility of total quality management theories and methodologies in the vocational training systems of Taiwan, Republic of China.

Directions:

1. *Do not write your name or sign anywhere in this booklet.*
2. *This questionnaire consists of four parts. Part 1 is a section about your background information that should be filled out on this booklet itself.*
3. *Parts 2, 3, and 4 of the questionnaire contains 67 items related to your perceptions about total quality management feasibility. Your responses for parts 2, 3, and 4 should be written on the "NCS Score Sheet" which is provided.*
4. *For each item, please select only ONE choice which corresponds most closely with your opinion. Consider each statement carefully.*
5. *All of your responses will be strictly confidential and will be reported only in aggregate form. The code in your questionnaire helps us for the follow-up purpose and to increase the questionnaire response rate.*
6. *After completing the questionnaire, please tape it shut and place it in the mailbox.*

Thank you for your assistance and cooperation.

Part 1

Background information for vocational training centers' instructors.
Please answer the following particulars about yourself/your training center on this booklet itself:

1. My job title is:
(a) Full Instructor
(b) Associate Instructor
(c) Assistant Instructor
(d) Other (Please specify)_____

2. The highest academic degree I have received is:
(a) Doctorate degree
(b) Masters degree
(c) Bachelors degree
(d) Other (Please specify)_____

3. Number of years of full-time working experience I have at the training center :
(a) 0-5 years
(b) 6-10 years
(c) 11-15 years
(d) more than 15 _____

4. Estimated number of hours of training I have in total quality management or continuous quality improvement within the past 5 years:
(a) 0 -10 hours
(b) 11-20 hours
(c) 21-30 hours
(d) more than 30 _____

5. Location of the training center where I teach:
City:_____ County:_____

6. My center provides this type of training:
(a) Training programs for skilled workers
(b) Training programs for instructors
(c) Training programs for skilled workers & instructors
(d) Other (Please describe)_____

7. My training center is sponsored by:
(a) government
(b) non government

8. Number of students currently enrolled at my training center:
(a) less than 100
(b) between 101 and 500
(c) between 501 and 1000
(d) more than 1000 _____

You may now proceed to parts 2, 3, and 4 of this questionnaire. Please remember that your responses for parts 2, 3, and 4 should be written on the "NCS Score Sheet" which is provided.

Total Quality Management Feasibility Instrument

Wang, Hsi-Kong Chin
Department of Industrial Education and Technology
Iowa State University

This instrument is designed to measure your perceptions regarding the feasibility of total quality management theories and methodologies in the vocational training systems of Taiwan, Republic of China.

Directions:

1. *Do not write your name or sign anywhere in this booklet.*
2. *This questionnaire consists of four parts. Part 1 is a section about your background information that should be filled out on this booklet itself.*
3. *Parts 2, 3, and 4 of the questionnaire contains 67 items related to your perceptions about total quality management feasibility. Your responses for parts 2, 3, and 4 should be written on the "NCS Score Sheet" which is provided.*
4. *For each item, please select only ONE choice which corresponds most closely with your opinion. Consider each statement carefully.*
5. *All of your responses will be strictly confidential and will be reported only in aggregate form. The code in your questionnaire helps us for the follow-up purpose and to increase the questionnaire response rate.*
6. *After completing the questionnaire, please tape it shut and place it in the mailbox.*

Thank you for your assistance and cooperation.

Part 1

Background information for companies' leadership.
Please answer the following particulars about yourself/your company on this booklet itself:

1. My job title is:
(a) President
(b) Vice President
(c) Manager
(d) Other (Please specify)_____

2. The highest academic degree I have received is:
(a) Doctorate degree
(b) Masters degree
(c) Bachelors degree
(d) Other (Please specify)_____

3. Number of years of full-time working experience I have at the company:
(a) 0-5 years
(b) 6-10 years
(c) 11-15 years
(d) more than 15 _____

4. Estimated number of hours of training I have in total quality management or continuous quality improvement within the past 5 years :
(a) 0-10 hours
(b) 11-20 hours
(c) 21-30 hours
(d) more than 30 _____

5. Location of the company where I work:
City: _____County:_____

6. My company's business is best described as:
(a) Manufacturing
(b) Service
(c) Manufacturing & Service
(d) Other (Please describe)_____

7. My company ownership category is:
(a) wholly owned
(b) common stock

8. Number of people employed in my company:
(a) less than 100
(b) between 101 and 500
(c) between 501 and 1000
(d) more than 1000 _____

You may now proceed to parts 2, 3, and 4 of this questionnaire. Please remember that your responses for parts 2, 3, and 4 should be written on the "NCS Score Sheet" which is provided.

Part 2

Trainees that attend the VTCs' courses should acquire the core body of knowledge of TQM. Please indicate your level of importance for each knowledge listed below in items 1-48. Just fill in the number that best represents your opinion on the NCS Score Sheet.

1. Identifying customers

Not Important						Very Important
1	2	3	4	5	6	7

2. Understanding customer expectations and requirements

Not Important						Very Important
1	2	3	4	5	6	7

3. Difference between internal and external customers

Not Important						Very Important
1	2	3	4	5	6	7

4. Proactively seeking feedback from customers

Not Important						Very Important
1	2	3	4	5	6	7

5. Measurement of customer satisfaction

Not Important						Very Important
1	2	3	4	5	6	7

6. Relationship between employee satisfaction and customer satisfaction

Not Important						Very Important
1	2	3	4	5	6	7

7. Definitions of quality according to experts and scholars

Not Important						Very Important
1	2	3	4	5	6	7

8. Selection of statistical process control tools

Not Important						Very Important
1	2	3	4	5	6	7

9. Quality control tools (Pareto diagram, Cause-and-effect diagram, Histogram, etc.)

Not Important						Very Important
1	2	3	4	5	6	7

10. Management and planning tools (Arrow diagram, Tree diagram, Matrix diagram, etc.)

Not Important						Very Important
1	2	3	4	5	6	7

11. Design of experiments

Not Important						Very Important
1	2	3	4	5	6	7

12. Activity-based cost management concepts

Not Important						Very Important
1	2	3	4	5	6	7

13. Plan-do-check-act cycle

Not Important						Very Important
1	2	3	4	5	6	7

14. Understanding variation

Not Important						Very Important
1	2	3	4	5	6	7

15. Cost of quality (Prevention cost, Appraisal cost, Failure cost, etc.)

Not Important						Very Important
1	2	3	4	5	6	7

16. Root-cause analysis

Not Important						Very Important
1	2	3	4	5	6	7

17. Recognizing data patterns and their implications

Not Important						Very Important
1	2	3	4	5	6	7

18. Operational definition (A definition that gives communicable meaning by specifying how the concept is measured and applied within a set of circumstances)

Not Important						Very Important
1	2	3	4	5	6	7

19. Concepts focusing on process rather than product

Not Important						Very Important
1	2	3	4	5	6	7

20. Flowcharting and process mapping

Not Important						Very Important
1	2	3	4	5	6	7

21. Difference between building in quality and inspecting in quality

Not Important						Very Important
1	2	3	4	5	6	7

22. Measuring processes

Not Important						Very Important
1	2	3	4	5	6	7

23. Difference between common and special causes

Not Important						Very Important
1	2	3	4	5	6	7

24. Process control concepts

Not Important						Very Important
1	2	3	4	5	6	7

25. Teamwork and people involvement

Not Important						Very Important
1	2	3	4	5	6	7

26. Leadership skills

Not Important						Very Important
1	2	3	4	5	6	7

27. Team-building skills

Not Important						Very Important
1	2	3	4	5	6	7

28. Team-meeting (facilitation) skills

Not Important						Very Important
1	2	3	4	5	6	7

29. Employee empowerment

Not Important						Very Important
1	2	3	4	5	6	7

30. Consensus development

Not Important						Very Important
1	2	3	4	5	6	7

31. Continuous improvement

Not Important						Very Important
1	2	3	4	5	6	7

32. Product design for quality

Not Important						Very Important
1	2	3	4	5	6	7

33. Difference between small and large quality improvements

Not Important						Very Important
1	2	3	4	5	6	7

34. Importance of design and re-design of processes

Not Important						Very Important
1	2	3	4	5	6	7

35. Relationship between continuous improvement and global competition

Not Important						Very Important
1	2	3	4	5	6	7

36. Cross-functional interaction

Not Important						Very Important
1	2	3	4	5	6	7

37. Development of new knowledge

Not Important						Very Important
1	2	3	4	5	6	7

38. Knowledge of oneself

Not Important						Very Important
1	2	3	4	5	6	7

39. Dealing with organizational change

Not Important						Very Important
1	2	3	4	5	6	7

40. Personal commitment and responsibility

Not Important						Very Important
1	2	3	4	5	6	7

41. Understanding learning styles

Not Important						Very Important
1	2	3	4	5	6	7

42. Systems thinking

Not Important						Very Important
1	2	3	4	5	6	7

43. Theory of constraints

Not Important						Very Important
1	2	3	4	5	6	7

44. Quality Award criteria (Baldrige Award, Deming Prize, etc.)

Not Important						Very Important
1	2	3	4	5	6	7

45. Organizational mission statement

Not Important						Very Important
1	2	3	4	5	6	7

46. Organizational goals and outcomes

Not Important						Very Important
1	2	3	4	5	6	7

47. ISO 9000 standards for quality systems

Not Important						Very Important
1	2	3	4	5	6	7

48. How important you feel it is to teach TQM to trainees at training centers?

Not Important						Very Important
1	2	3	4	5	6	7

Part 3

Instructors who teach the VTCs' courses can improve their knowledge of TQM principles and methods through various opportunities. Please indicate your level of preference for each opportunity listed in items 49-58. Just fill in the number that best represents your opinion on the NCS Score Sheet.

49. An industry executive with TQM expertise would work on-site at a training center for a 6-12 month period to provide TQM education to the faculty.

Low preference						High preference
1	2	3	4	5	6	7

50. A senior faculty member from a college or university with real world TQM experience would work at a training center for a 6-12 month period to provide TQM education to the faculty.

Low preference						High preference
1	2	3	4	5	6	7

51. Training center faculty members would spend 1-4 months at a leading TQM company or college/university studying the TQM practice.

Low preference						High preference
1	2	3	4	5	6	7

52. A series of (3-5) two-hour television broadcasts aimed at establishing the basic steps that can be taken to incorporate TQM into the training center's curriculum will be presented.

Low preference						High preference
1	2	3	4	5	6	7

53. A one-week session would be sponsored by professional TQM societies/organizations and taught by university faculty, industry executives TQM experts and scholars from around the world. The objectives are to build awareness of TQM concepts and explain the approaches for incorporating TQM into the training center's curriculum.

Low preference						High preference
1	2	3	4	5	6	7

54. A critical mass (35%-75%) of training center faculty members would visit a company for 4-5 days with the purpose of learning about TQM. Following this initial experience, an ongoing relationship (every week for two years) with the company for the continued learning about TQM would be established. This would include sharing of TQM education through the company's classes and the opportunity to observe and participate in the TQM practice at the company.

Low preference						High preference
1	2	3	4	5	6	7

55. Training center faculty would attend conferences of 200-800 participants sponsored by higher educational institutions, TQM-oriented organizations/societies, or business associations to learn about TQM.

Low preference						High preference
1	2	3	4	5	6	7

56. Training center faculty would attend 2-3 days TQM courses on campus (typically 25 participants per course) that are similar to those that businesses normally provide to their employees. These courses will be provided directly by companies, professional associations, or consultants that normally provide TQM education to business.

Low preference						High preference
1	2	3	4	5	6	7

57. Workshops would be sponsored by professional TQM societies/organizations that focus on specific issues of TQM such as strategic planning, emerging curricula topics, strategies for developing teamwork, quality indicators, benchmarks, and implementation.

Low preference						High preference
1	2	3	4	5	6	7

58. A TQM resource guide including class outlines and materials, reading, and teaching notes that represent alternative approaches being used in higher education and companies would be produced for vocational training centers' faculty.

Low preference						High preference
1	2	3	4	5	6	7

Part 4

VTCs could use many strategies for including TQM practices into their curriculum. Please indicate your level of agreement with each strategy listed in items 59-67. Just fill in the number that best represents your opinion on the NCS Score Sheet.

59. The teaching of quality must be integrated within the contents of individual courses as well as across the entire curriculum.

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

60. Vocational trainers should emphasize interdisciplinary faculty teams to teach quality to trainees.

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

61. The practice of quality principles should encompass everything from continuous improvement of the administrative functions to the process for curriculum development to the teaching methods used in the classroom.

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

62. Vocational training centers should establish "Quality Improvement Teams" to facilitate continuous improvement of their training programs.

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

63. Vocational training centers should treat companies that send their employees to the centers as customers and seek their feedback for improvement.

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

64. Curriculum revision should involve researching the requirements of students, parents, society, alumni, employers, and faculty.

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

65. All stakeholders including faculty, staff, and students at the centers must be actively involved in the learning process of TQM from the beginning of the program.

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

66. Having a strong and involved leadership at vocational training centers is the key to successful implementation of TQM curriculum.

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

67. The processes for anticipating and responding to future requirements of industry are important for vocational training centers.

Strongly disagree						Strongly agree
1	2	3	4	5	6	7

APPENDIX E

APPROVAL LETTER FROM DIRECTOR-GENERAL

Dr. Robert J. Gelina
Associate Professor
Department of Industrial
Education and Technology
Iowa State University
Ames, Iowa 50011

Dr. Tsong-Ming LIn
Director-General
Employment and Vocational Training
Administration,
Council of Labor Affairs,
Executive Yuan,
Taipei, Taiwan, R.O.C.

June 25, 1998

Dear Dr. Robert J. Gelina:

Hsi-Kong Chin Wang was a senior specialist of Employment and Vocational Training Administration, Council of Labor Affairs, Executive Yuan. Her study titled " The Perceptions of the Feasibility of Total Quality Management Theories and Methodologies in the Vocational Training Systems in Taiwan, Republic of China" has been permitted to conduct at thirteen vocational training centers. The guideline of research involving human subjects established by Review Committee of Iowa State University will be respected in this study.

Sincerely yours,

Tsong-Ming Lin

Director-General

Employment and Vocational

Training Administration

APPENDIX F

HUMAN SUBJECTS APPROVAL FORM

Last name of Principal Investigator Wang

Checklist for Attachments and Time Schedule

The following are attached (please check):

12. ☒ Letter or written statement to subjects indicating clearly:
    a) the purpose of the research
    b) the use of any identifier codes (names, #'s), how they will be used, and when they will be removed (see item 17)
    c) an estimate of time needed for participation in the research
    d) if applicable, the location of the research activity
    e) how you will ensure confidentiality
    f) in a longitudinal study, when and how you will contact subjects later
    g) that participation is voluntary; nonparticipation will not affect evaluations of the subject

13. ☐ Signed consent form (if applicable)

14. ☒ Letter of approval for research from cooperating organizations or institutions (if applicable)

15. ☒ Data-gathering instruments

16. Anticipated dates for contact with subjects:

First contact	Last contact
July 9, 1998	August 8, 1998
Month/Day/Year	Month/Day/Year

17. If applicable: anticipated date that identifiers will be removed from completed survey instruments and/or audio or visual tapes will be erased:

December 31, 1998
Month/Day/Year

18. Signature of Departmental Executive Officer | Date | Department or Administrative Unit

Roger A. Smith | 6/30/98 | Industrial Education & Technology

19. Decision of the University Human Subjects Review Committee:

☒ Project approved ☐ Project not approved ☐ No action required

Patricia M. Keith | 7/8/98 | Signature of Committee Chairperson

Name of Committee Chairperson | Date

APPENDIX G

COVER LETTER

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Education

Departmental of Industrial
Education and Technology
114 L Ed. II
Ames, Iowa 50011 - 3130
(515)294-1033
Fax (515)294-1123

July 9, 1998
[Name]
[Address]
[City, State, Zip Code]

Dear [Name]:

Thank you for your assistance in completing a questionnaire as part of a study to assess the feasibility of total quality management (TQM) education to trainees that attend courses conducted by vocational training centers (VTCs). As stakeholders in the future of Taiwanese business and industry, we hope you agree that vocational training programs for current and future employees in industries needs continuous improvement. This questionnaire is being given to you as part of a study to measure your perceptions. Your response is very important as it will make a significant contribution to this study.

There are four parts in the instrument:

Part 1. You will be asked some basic questions about yourself and your organization.

Part 2. You will be asked to rate how important it is for trainees who attend the VTCs' courses to acquire specific TQM related knowledge, using a seven-point scale (1= not important, 7= very important).

Part 3. You will be asked to rate your preferences on learning opportunities for instructors who teach the VTCs' courses to improve their knowledge of TQM principles and methods, using a seven-point scale (1= low preference, 7= high preference).

Part 4. You will be asked to rate your agreements on several strategies for including TQM practices into VTCs' curriculum, using a seven-point scale (1= strongly disagree, 7= strongly agree).

All responses are voluntary and will be kept confidential. Please consider each question carefully and give your honest opinion. Your responses will be aggregated with similar participants, and the results reported as group data only. The code in your questionnaire helps us in the follow-up request to increase the questionnaire response rate.

Please take about twenty minutes to complete the questionnaire and then tape it shut and place it in the mailbox, no stamp is required. Thank you very much for your cooperation and assistance.

If you have any questions about this research or the instrument itself, please call one of the numbers below.

Sincerely,

Hsi-Kong Chin Wang
Doctoral Candidate
(515)292-3014

Dr. Robert J. Gelina
Associate Professor
(515)296-9796

Dr. Roger A. Smith
Professor
(515)294-2539

APPENDIX H

FOLLOW-UP LETTER

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of Education

Departmental of Industrial Education and Technology
114 I. Ed. II
Ames, Iowa 50011 - 3130
(515)294-1033
Fax (515)294-1123

August 8, 1998
[Name]
[Address]
[City, State, Zip Code]

Dear [Name}:

Recently your assistance was requested in completing a questionnaire as part of a study to assess the feasibility of total quality management theories and methodologies in the vocational training system of Taiwan. Perhaps you have been busy and that is why I have not received your completed questionnaire for the study. Your response is very important as it will make a significant contribution to this study.

As mentioned in my last letter, all responses are voluntary and will be kept confidential. Please consider each question carefully and give your honest opinion. Your responses will be aggregated with similar participants, and the results reported as group data only. The code in your questionnaire helps us in the follow-up request to increase the questionnaire response rate.

Please take about twenty minutes to complete the questionnaire and then tape it shut and place it in the mailbox, no stamp is required. If you have already mailed the questionnaire, please disregard this notice. Thank you very much for your cooperation and assistance. If you have any questions about this research or the instrument itself, please call one of the numbers below.

Sincerely.

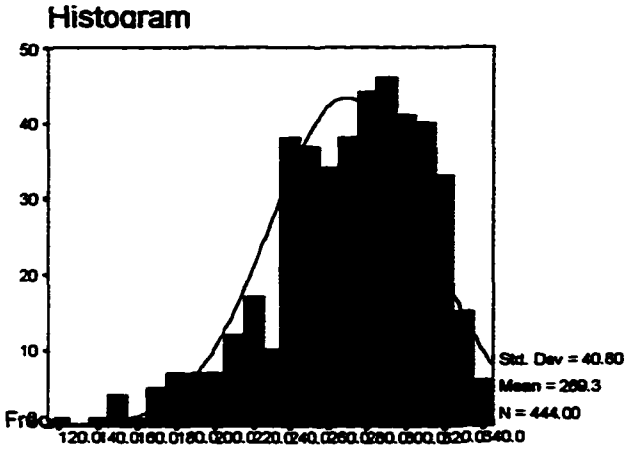
Hsi-Kong Chin Wang
Doctoral Candidate
(515)292-3014

Dr. Robert J. Gelina
Associate Professor
(515)296-9796

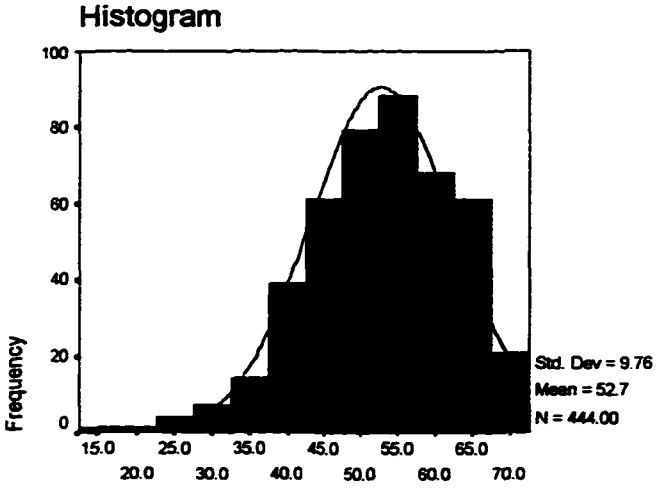
Dr. Roger A. Smith
Professor
(515)294-2539

APPENDIX I

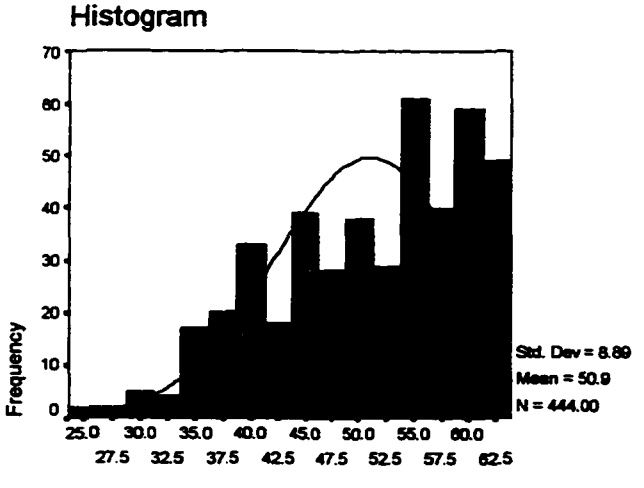
DISTRIBUTION OF SCALES



SCALE1



SCALE2



SCALE3

REFERENCES

Andel, T. (1990, June). Trust, but verify. *Appliance Manufacturer, 38*, 68.

ANSI/ISO/ASQ A8402. (1994). *Quality management and quality assurance-vocabulary*. [On-line]. Available: http://www.asq.org/abtquality/faqs.html.

Axland, S. (1992, October). A higher degree of quality. *Quality Progress*, 41-61.

Back to school with quality. (1994, October 17). *Fortune, 130*, 20.

Bax, R. M. (1994). *An assessment of the quality improvement climate as perceived by community college leadership in Iowa.* Doctoral dissertation, Iowa State University, Ames, IA.

Borg, W. R., & Gall, M. D. (1983). *Educational research: An introduction* (fourth ed.). New York, NY: Longman, Inc.

Boyes, R. L. (1981, March). *Corporations and inter-institutional cooperation in higher education.* Position paper. Annual Meeting of the Council on Inter-institutional Leadership, Racine, WI., 8.

Brocka, B., & Brocka, S. M. (1992). *Quality Management: Implementing the best ideas of the masters*. Homewod, IL: Business One Irwin.

Busby, J. S., & Williams, G. M. (1993). The value and limitations of using process models to describe the manufacturing organization. *International Journal of Production Research, 31(9)*, 2179-2194.

Carnevale, A. P. (1991). *America and the new economy*. San Francisco, CA: Jossey Bass.

Employment and Vocational Training Administration, Council of Labor Affairs, Executive Yuan. (1997). *Catalog of Vocational Training Centers of Employment and Vocational Training Administration*. Taiwan, Republic of China: Author.

Chai, C. C. (1995, July). Automating techniques for quality control systems. *Journal of Mechanical Engineering Industry, 148*, 181-184.

Chau, K. C. (1992, September). The impact of quality control circles on employee working attitude and job performance - a food processing plant case study. *Human Resource Review, 2*, 17-32.

Chen, H. J., Huang, Y. C., Liow, J. H., Wang, M. T., & Wang, S. C. (1996, May). A planning reference model for total quality management of central and satellite production's system. *Journal of Lee-Ming Institute of Technology, 10(1)*, 139-148.

Cheng, T. J. (1992/93, Winter). Dilemnas and choices in educational policies: The case of South Korea and Taiwan. *Studies in Comparative International, 27(4)*, 54-79.

Cheng, Y. C., Lin, B. Y., Wang, H. C., & Lee, C.C. (1996 August). The implementation and application of SQC at China Steel Corporation. *Journal of Techniques and Training, 21(4)*, 68-79.

Chiu, T. F. (1994/95). An application of expert systems in quality monitoring and diagnosis based on the combination of case-based reasoning and critiquing method. *Tamsui Oxford Journal of Management Sciences, 10(11)*, 1-23.

Copa, G. H. (1993). Continuous quality improvement in a universal setting: The case of the department of vocational and technical education at the University of Minnesota. *The Journal for Vocational and Special Needs Education, 15(3)*, 50-52.

Corson, D. (1991, April). Quality partnerships: The community college and business and industry. *Transaction of the AQP's 13th Annual Spring Conference*. Baltimore, Maryland: Association of Quality Progress, 483-487.

Dean, E. B. (1995). *Total quality management from the perspective of competitive advantage.* [On-line]. Available: http://akao.larc.nasa.gov/dfc/tqm.html.

Deming, W. E. (1986). *Out of the crisis*. Cambridge, MA: Massachusetts Institute of Technology, Center for Advanced Engineering Study.

Deming, W. E. (1993). *The new economics for industry, government, education*. Cambridge, MA: Center for Advanced Engineering Study, MIT.

Dingus, V. R., & Golomski, W. A. (1988). *A quality revolution in manufacturing*. Norcross, GA: Industrial Engineering and Management Press.

Ehresman, T. (1995). Continuous improvement and process reengineering: Complementary ideas or conflicting philosophies. *Proceedings of the 7th National Quality Management Conference*. San Antonio, TX: American Society for Quality Control.

Employment and Vocational Training Administration, Council of Labor Affairs, Executive Yuan. (1997). *Employment and Vocational Training Administration Handbook.* Taiwan, Republic of China: Author.

Evans, J. R. (1996, August). What should higher education be teaching about quality? *Quality Progress*, 83-88.

Feigenbaum, E. A., McCorduck, P., & Nil, H.P. (1988). *The rise of the expert company: How visionary companies are using artificial intelligence to achieve higher productivity and profits*. New York, NY: Times Book.

Gabor, A. (1990). *The man who discovered quality*. New York, NY: Times Books.

Garvin, D. A. (1988). *Managing for quality: The strategic and competitive edge*. New York, NY: The Free Press.

Gelina, R. J. (1992, January). Understanding and implementing the Deming management philosophy. *Print News, 12-13*, 22.

Gelina, R. J. (1993). *Continuous quality improvement: Student manual*. Ames, IA: Center for Continuous Quality Improvement.

Gitlow, H. S., Einspruch, N. G., Loredo, E. N., & Percival, M. M. (1994*). Quality management: A curriculum resource guide*. American Assembly of Collegiate Schools of Business.

Goetsch, D. L., & Davis, S. B. (1997*). Introduction to total quality: Quality management for production, processing, and services*. Upper Saddle River, NJ: Prentice-Hall.

Goldstein, I. L. (1993). *Training in Organizations: Needs Assessment, Development, and Evaluation.* Pacific Grove, CA: Brooks/Cole Publishing Company.

Goldratt, E. M., & Cox, J. (1986). *The goal: A process of on-going improvement.* New York, NY: North River Press.

Halachmi, A. (1996, June). Total quality management, performance appraisal and training: Selected issues and implications. *The Chinese Public Administration Review, 5(3)*, 63-82.

Hart, M. K. (1991, Third Quarter). Quality control training for manufacturing. *Production and Inventory Management Journal*, 35-40.

Horine, J. E., Halley, J. E., & Rubach, L. (1993, October). Shaping America's future: Total quality management in higher education. *Quality Progress*, 41-60.

Hung, J. F., Liau, J. H., Wang, S. Y., Shain, M. C., Fang, Y. E., Shui, C. R., & Chen, J. R. (1996, February). Application of the Deming's management methodologies to assess the effectiveness of hospital management. *Journal of Hospital Management. 29(1)*, 25-34.

Hurley, R. F., & Laitamaki, J. M. (1995, Fall). Total quality research: Integrating markets and the organization. *California Management Review, 38*, 59-78.

Isaac, S., & Michael, W. B. (1995). *Handbook in research and evaluation for education and the behavioral sciences* (third ed.). San Diego, CA: EdITS/Educational and Industrial Testing Services.

Jang, C. C. (1994, November). TQM in Taiwan: Current situation and future direction. *Journal of Management, 245*, 62.

Jang, T. J. (1992). *The study on critical successful factors and implementation of Total Quality Management in Taiwan, Republic of China*. Master's Thesis, National Chung-San University. Taiwan, Republic of China.

Johnson, D. A., & Dugger, J.C. (1996, Spring). Assessing the impact of SPC/TQM training programs. *Journal of Industrial Technology*, 35-40.

Johnson, R. S. (1993). *TQM: Leadership for quality transformation*. Milwaukee, WI: ASQC Quality Press.

Juran, J. M. (1995). Summary, trends, and prognosis. In Juran, J. M. (Ed.), *A history of managing for quality: The evolution, trends, and future directions of managing for quality*. Milwaukee, WI: ASQ Quality Press.

Kao, S. Y. (1995, April). Don't wait, don't depend on, achievement will not come from heaven. *Bi-monthly Journal of Research and Evaluation, 19(2)*, 57-65.

Katzenbach, J. R., & Smith, D. K. (1993, March-April). The discipline of teams: What makes difference between a team that performs and one that doesn't. *Harvard Business Review*, 111-120.

Kerr, R. (1982). *Psychomotor learning*. Philadelphia, PA: Saunders College Publication.

Kusiak, A., & Dorf, R.C. (1994). *Handbook of design, manufacturing, and automation*. New York, NY: Wiley.

Li, H. H. (1996, November). Total quality management in the public sector. *Open Public Administration Review, 6*, 417-440.

Li, H. H. (1997, March). The theorem of team. *The Chinese Public Administration Review, 6(2)*, 73-86.

Lin, T. M. (1998, February). Personal communication. (Dr. Lin is the Director-General of Employment and Vocational Training Administration, Council of Labor Affairs, Executive Yuan, Taiwan, Republic of China).

Lu, C. M. (1996, November). Is Total Quality Management a returning ghost of the scientific management of 1920s? *Open Public Administration Review, 6*, 441-458.

Madu, C. N., Kuei, C. H., Lin, C. (1995). A comparative analysis of quality practice in manufacturing firms in the U. S. and Taiwan. *Decision Sciences, 26(5)*, 621-635.

Marchese, T. (1993, May/June). TQM: A time for ideas. *Change*, 10-13.

Miller, D. & Daniels S. E. (1998, September). Quality Progress'8th Quality in Education Listing. *Quality Progress*, 25-64.

Miller, V. A. (1987). The history of training. In Craig, R. L. (Ed.). *Training and development handbook: A guide to human resource development*. New York, NY: Mc-Graw Hill Book Company.

Ministry of Economic Affairs, Executive Yuan. (1997). *Ministry of Economic Affairs Handbook* (1997). Taiwan, Republic of China: Author.

Monden, Y. (1993). *Toyota management system: Linking the seven key functional areas*. Portland, OR: Productivity Press.

Morup, M. (1992). A new design for quality paradigm. *Journal of Engineering Design, 3(1)*, 63-80.

Needham, R. L. (1992). *Process improvement teams: A TQM strategy for improving community college systems.* Paper presented at Leadership 2000, the Annual International Conference of the League for Innovation in the Community College and the Community College Leadership Program. (ERIC Document Reproduction Service No. Ed 348-107).

Nunnally, J. C. (1978). *Introduction to psychological measurement*. New York, NY: McGraw-Hill, Inc.

An open letter-TQM on the campus. (1991, November/December). *Harvard Business Review*, 94-95.

Pan, C. T. (1996). *Feasibility study on the administration to implement Total Quality Management for vocational training institutes in Taiwan, Republic of China.* Master's Thesis, National Chang-Hwa University, Taiwan, Republic of China.

Pan, J. N. (1993, November). Total Quality Management implementation strategy and self-assessment using Malcolm Baldrige award criteria. *Journal of National Cheng-Kung University, 28,* 175-184.

Parry, S. B. & Ouweneel, W. M. (1987). Consultants. In Craig, R. L. (Ed.), *Training and development handbook: A guide to human resource development.* New York, NY: Mc-Graw Hill Book Company.

Pittam, J. L. (1987). Organization and management of the training function. In Craig, R. L. (Ed.), *Training and development handbook: A guide to human resource development.* New York, NY: Mc-Graw Hill Book Company.

Potocki, K. A. (1995, November). Finding a common TQM definition. *Quality Progress,* 12-14.

The Proctor and Gamble Company. (1992, November). *A Report of the Total Quality Leadership Steering Committee and Working Councils.* 1992 Total Quality Forum. Cincinnati, Ohio: The John K. Howe Company, Inc.

Ross, J. E. (1995). *Total Quality Management: Text, cases and readings* (2nd ed.). Delray Beach, FL: St. Lucie Press.

Rzadzki, J. (1994, February 7). The bright spot: Far Eastern regions represent potential for investment opportunities and future growth. *Chemical-Marketing-Reporter, 245,* SR21-SR23.

Saylor, J.H. (1992). *TQM field manual.* New York, NY: McGraw-Hill.

Seymour, D. T. (1993). *On Q: causing quality in higher education.* Phoenix, AZ: The Oryx Press.

Seymour, D. T., & Collett, C. (1991*). Total Quality Management in higher education: A critical assessment.* (Report N. 91-01). Methuen, MA: Goal/QPC.

Shapiro, D. (1991, December). Back from the brink. *Asian Business, 27,* 44.

Shiba, S., Graham, A. & Walden, D. (1993*). A new American TQM: Four practical revolutions in management.* Portland, Oregon: Productivity Press.

Shuster, H. D. (1994, January). Making cultural change happen: Putting management transformation theory to use. *Quality Management Journal*, 7-17.

Spanbauer, S. J. (1992). *A quality system for education: Using quality and productivity techniques to save our schools*. Milwaukee, WI: ASQC Quality Press.

Taiwan-the dream postponed. (1993, August 7). *The Economist, 328*, 36.

Taiwan's big prize. (1995, April 15). *The Economist, 335*, 62-63.

Teegarden, J. (1996). *TQM comes to the Carter Company: A case study of quality improvement teams in a Total Quality Management initiative in a mid-sized manufacturing company*. Doctoral dissertation, Iowa State University, Ames, IA.

Thurow, L. C. (1996). *The future of capitalism: How today's economic forces shape tomorrow's world*. New York, NY: W. Morrow and Co..

Tseng, C. K. (1995). *A study on course design of Total Quality Management for university students*. Master's Thesis, Chung-Yan University, Taiwan, Republic of China.

Walton, M. (1986). *The Deming management method*. New York, NY: Putnam Publishing.

Waylett, W. J. (1990, July). Winning the Deming: Florida Power & Light. *Technical & Skill Training Journal*, 37-46.

Weinstein, L. B., Petrick, J. A., & Saunders, P.M. (1998). What higher education should be teaching about quality-but is not. *Quality Progress, 31(4)*, 91-95.

Westbrook, J. R. (1993). Taiwan-made items receive image boost. *Advertising Age, 64(3)*, I-8.

Witcher, B. (1995). The changing scale of Total Quality Management. *Quality Management Journal, 2(4)*, 9-29.

Wu, S. C. (1991, April). Prospects for economic growth in Republic of China of Taiwan. *Mid-Atlantic Journal of Business, 27(Special issue)*, 57-59.

Yang, J. C. (1994, November). Problems encountered in TQM Implementation in Taiwan. *Journal of Management, 245*, 64-65.

Yei, U. E. (1995, June). Quality Control Teaching Practice and Quant Systems 2.0. *Journal of Yai-Tung Institute of Technology, 15*, 5-1-5-30.

Zhau, M. C. (1992, October). Comparison of Japanese quality control with European and American quality control. *Taiwan Handicraft Review*, *45*, 14-22.

ACKNOWLEDGMENTS

First and most importantly, I wish to express my sincere appreciation to Dr. Robert Gelina and Dr. Roger Smith, my co-major professors, for their help, support, active guidance, and assistance in the development and completion of this study. I am particularly thankful to Dr. Gelina for inspiring me to pursue research in Total Quality Management, and helping me in spite of his very busy schedule as the director of the Center for Continuous Quality Improvement. Dr. Smith, thank you for continual support and words of encouragement throughout the duration of this study.

The help received from my program of study committee members: Dr. Sharon Drake, Dr. Steffen Schmidt, and Dr. Mack Shelley were extraordinary. I am extremely thankful to each one of them for their friendly suggestions and input during all stages of this study. I would also like to thank Dr. Jeffrey Flesher and Dr. Chao-Hsien Chu for their help during the initial stage of my graduate study.

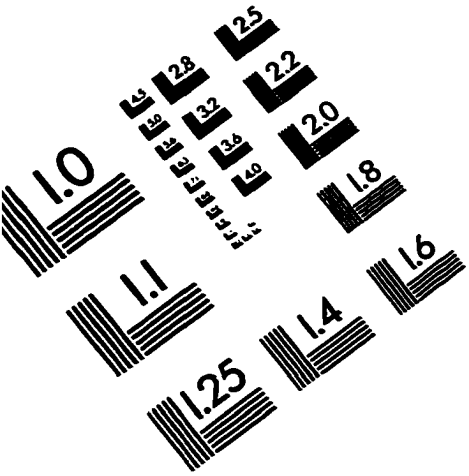
A special thanks goes to the late Dr. William Wolansky, former Chair in Department of Industrial Education and Technology, who was primarily responsible in motivating me to pursue the Ph.D. program at Iowa State University. I would also thank to Dr. Larry Ebbers, Associate Dean of College of Education, for providing valuable professional experiences. Dr. William Miller, thanks to your dedication and commitment, I thoroughly enjoyed your class and have a deep respect for your mastery of the subject. I would also like to thank the late Dr. John Beno, Dr. Radha Balamuralikrishna, and faculty members for their support and friendly guidance during my stay here.

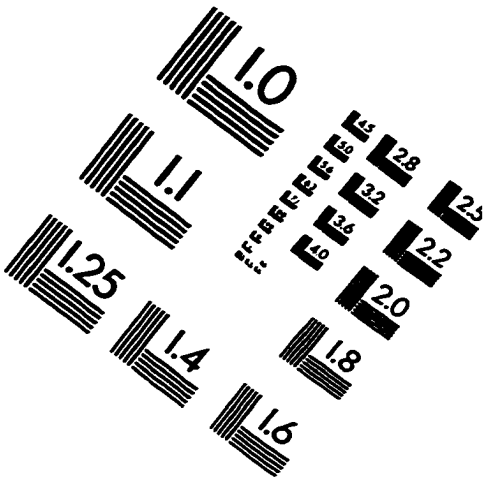
A note of special thanks goes to my many colleagues and friends including Frank Chao, David Chen, Andrew Hung, and Richard Kang. I had the good fortune to work with these excellent people and learn about many aspects of doctoral quality research. I wish my friends, Steven Bell, Farhad Jadali, Gary Schnellert, and Victor Udin, success in their careers. I am especially thankful to Karleen Gillen for her untiring efforts in editing this dissertation.

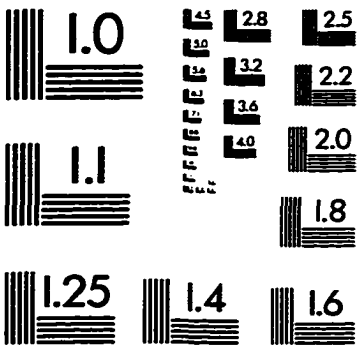
I would like to thank Dr. J. M. Chen, President of National Normal Chang-Hua University in Taiwan, for providing me with the scholarship to partly finance my education. I would also like to thank Dr. T. M. Lin, Director-General of Employment and Vocational Training Administration of Council of Labor Affairs in Taiwan, to support me with the opportunities to complete my studies, including this research.

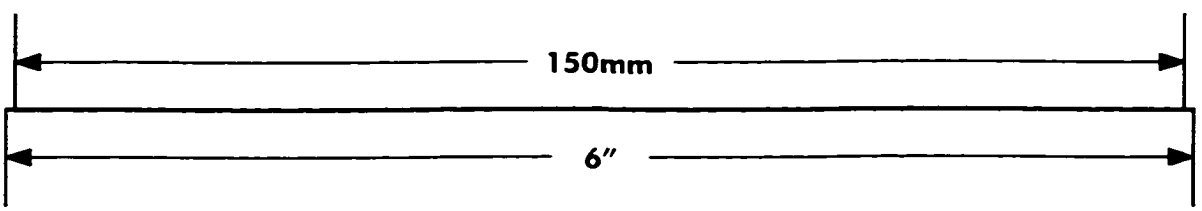
Finally, I would like to thank my husband, Peter Wang, for providing me with the support and encouragement and also my sons, Wade Wang and Wayne Wang, for looking after my affairs while I was away from home. I wish to thank my late mother and my father for teaching me the value of a good education, the sense to work hard, and aiming to achieve high goals.

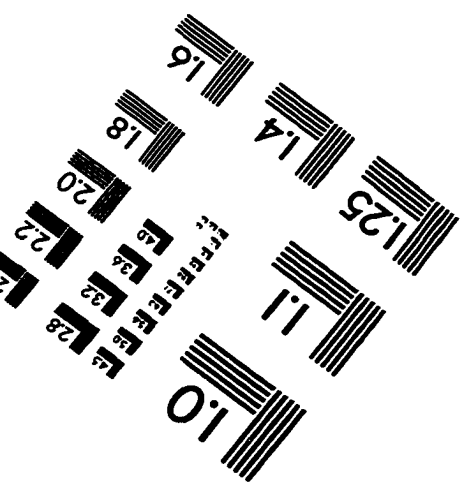
IMAGE EVALUATION
TEST TARGET (QA-3)

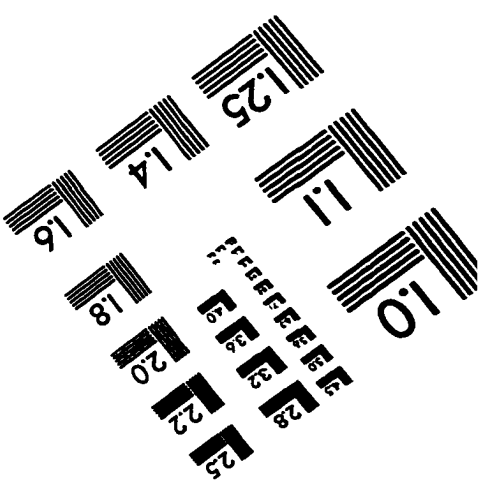












APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989